April, 1958
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# ARMED FORCES management

PUBLISHED FOR THE ARMY, NAVY, AIR FORCE, COAST GUARD AND MARINE CORPS

## AFSWP . . . Its Role in Nuclear Testing . . . p. 6

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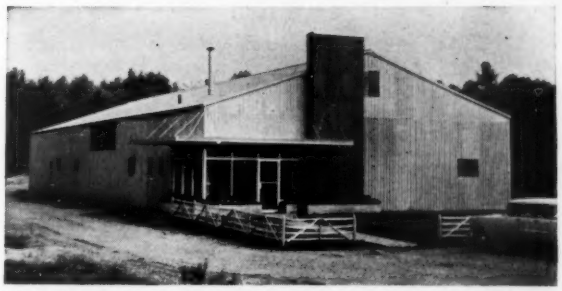

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# ARMED FORCES management

PUBLISHED FOR THE ARMY, NAVY, AIR FORCE, COAST GUARD AND MARINE CORPS

APRIL, 1958



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**ARMED FORCES MANAGEMENT** **Volume 4—No. 7**

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# In My Opinion

## Ten Commandments

We read with interest the article in your January issue by Lt. Col. C. V. Glines, USAF, entitled "Ten Commandments for Dealing with the Press." May we have permission to reproduce the article with appropriate credit?

*R. H. Mereness*
Commander, USN
Assistant for Information

**Permission Granted—Ed.**

Since the "Ten Commandments" are my own idea, I would like to see them adopted service-wide . . . I liked the treatment your editor made of it without detracting from my basic message.

*C. V. Glines*
Lt. Col., USAF

Lt. Col. Glines article entitled "Ten Commandments for Dealing with the Press" which appeared in the January 1958 issue, has just been brought to my attention and it is the finest piece of this type that I have ever read.

*Cook Cleland*
Cmdr., USNR
U.S. Naval Air Station
Glenview, Ill.

. . . . This hits the nail on the head on our job in the Technical Liaison Branch of the U.S. Army Engineer District, Alaska.

*Bob Knox*
Chief, Technical Liaison Branch

## Command & Management

The Command and Management Cycle diagram in the January '58 issue of ARMED FORCES MANAGEMENT gives a clear, concise outline of the Command-Management System. I believe it is worked out in such a manner that it could be clearly understood by all types of employees. I would like permission to have this chart reproduced and placed in the various offices throughout the installation.

*Col. John A. Supensky*
Commander
Tooele Ordnance Depot

## Reprints

Thank you for granting us permission to reprint the material from the February issue. ARMED FORCES MANAGEMENT is considered an excellent source for material as a training aid.

*Col. W. E. Sievers*
Commandant, U.S. Army
Finance School
Fort Benjamin Harrison, Indiana

EDITORIAL

# The Chaotic Error of Part-time Pentagon Management

IT IS becoming increasingly apparent to the men who make a study of such things that the part-time management of the Pentagon threatens to hobble our military effort unless it is stopped.

The constant shuttling in and out of civilians in key positions at top-policy level in our military structure is creating an operation by amateurs at what is probably one of the most critical times in the history of our Nation's defense. To be sure, they are usually top men in their fields in private industry. But what is too little realized and never noted is that the Department of Defense, from strictly a business-operation standpoint, is an organization unique in the world. Its very size creates problems not found in any other "business" operation.

It takes time for any man, no matter how gifted, to even understand this mammoth parked on the Potomac. It takes even more time for any civilian in a top policy role to pick up the reins from his predecessor and move on a sound, justifiable military program.

Yet, time is just what these key civilians do *not* spend in the Pentagon. Charles Wilson set a record by serving nearly five years as Secretary of Defense. Four men—James Forrestal, Louis Johnson, George Marshall and Robert Lovett—split the first five years of DOD direction among them.

The record of longevity for eight of the nine assistant secretaries of defense has been no better. The top jobs here have been held by a total of no less than 27 persons during Wilson's tenure alone.

The number of civilians who have held major positions and stayed with the Department of Defense since its founding in 1947 is only a handful—something like 30. Outstanding in this group is Defense Comptroller W. J. McNeil. Pentagon "Indians" frequently assert (off the record, of course) that if it were not for this one man with over 10 years experience, Defense funding (complicated and confusing anyway) would be an annual crisis.

Pentagon confusion has been a long-standing joke among the services. There is a growing fear, however, among military personnel that it is something a good deal more harmful—and the core of the problem can be tied directly to indecision at the top. Certainly, the men who accept this civilian leadership cannot be charged with inability to make decisions *per se*. They have already proven themselves in private industry. The only logical conclusion is that they just are not around long enough to plan and carry out effectively a long-term program.

This throws on the military personnel the extra burden of constantly proposing and reproposing their plans—only to see them swallowed up by civilian staffs whose sole purpose is to brief an assistant secretary on something with which, as a key member of the team, he should already be familiar.

This military fear that their own civilian bosses are their biggest problem has cropped up frequently in recent weeks. It can usually be identified by the title "An Unawareness of Military Needs." Among the examples:

**1—Research and Development:** Military people in the program, privately, and some even publicly, have attributed nearly all the confusion in the military missile program to the back-tracking, decide-rescind-decide, "flea-flicker" performance of civilians to whom they went—long before there was a missile crisis—for an OK or refusal.

**2—Military Pay Boost:** The pay bill recently passed by the House is far more popular among the services than anything proposed by the Pentagon.

**3—Defense Reorganization:** Allowing for the fact that some of the ideas on a Pentagon change coming from Congress are as crazy as Alice in Wonderland, certain congressmen (with 25 or 30 years experience dealing with the military) have proposed very sound, workable changes—the important point here being they were proposed almost immediately. The Pentagon started in January, was still working on its answer in April. One reason the DOD is slow: it is assembling the recommendations of men with prior experience. Why? Because there isn't enough background in the group there now to risk such a major move without help.

It is interesting to note that few major positions (McNeil excepted) in the civilian leadership are manned by persons brought up from within the organization—a complete contradiction of the desired practice in private industry.

If Congress or the Administration would make these positions more appealing to the employees so that they stick around long enough to become thoroughly familiar with the organization and its problems, reorganization talk would probably become academic. Until they do, it is a safe bet there will continue to be indecision and unwarranted delays in the Pentagon.

## Trouble at the Ranch

UNLESS things change rapidly, certain officer and NCO grades with a tour of duty coming up in Germany are going to finish the tour highly disgusted with the military. A recent decision, because of a reported housing shortage, to use maids' quarters for temporary (up to nine months) housing means a great many personnel are going to be trying to house their families in one-room cracker boxes under the eaves or in the basement—the usual spots for maids' quarters. Unless this situation is quickly changed, tours of duty in Germany are suddenly going to become something to energetically avoid.

# AFSWP . . . Its Role in Nuclear Testing

by Rear Admiral Edward N. Parker

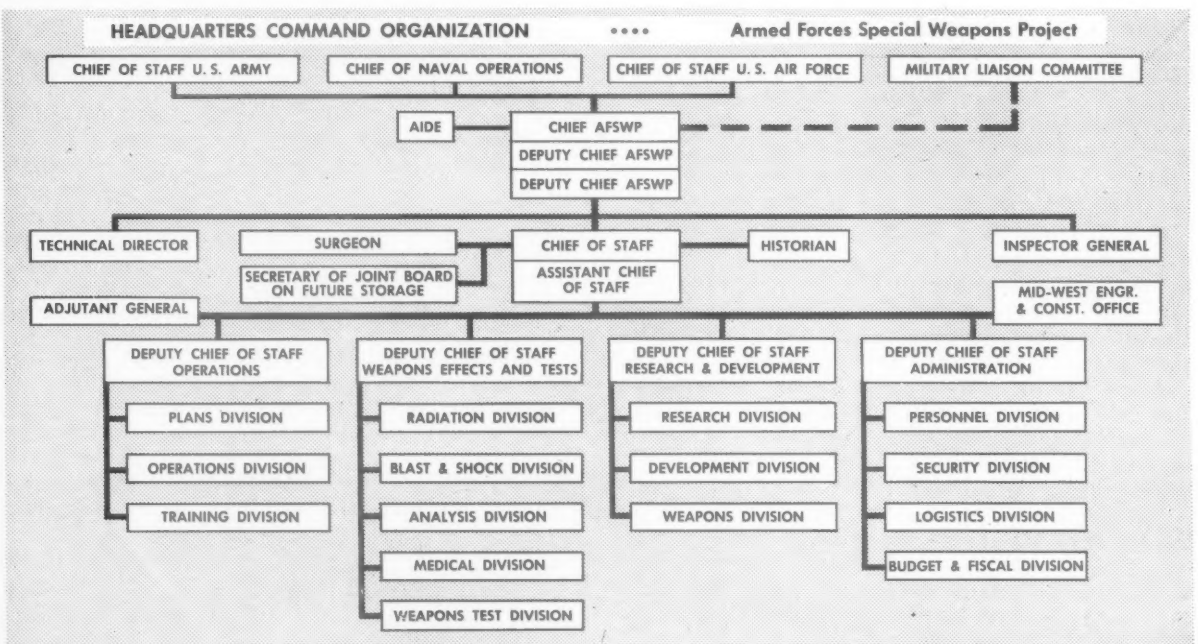
IN ONE brilliant flash of light and flame, the very nature of matter is altered, producing a surge of energy never before equalled outside the suns of the universe. In this fraction of an instant many things occur which must be fully studied if we are to profit from unlocking the door of the atom. Months of planning enter into instrumenting each test event to insure that each shot bears more fruit than "just" the detonation.

Primary purposes of nuclear testing are twofold. The first is to test principles of weapons design to meet Service criteria, and to permit more efficient utilization of nuclear materials. The second is to insure that sufficient effects information is generated to permit proper evaluation; to insure that the users of weapons can select the right one for the purpose intended. The Armed Forces Special Weapons Project (AFSWP) is concerned with both of these primary purposes. The AFSWP assists the Services in determining the criteria upon which subsequent designs by the Atomic Energy Commission are based; however, it is the effects studies in which the major effort on the part of AFSWP is expended.

AFSWP is an interdepartmental agency of the Department of Defense, jointly staffed by personnel of the Army, Navy, Air Force and Marine Corps. The Chief, AFSWP, is appointed by the Joint action of the Chiefs of the military services and is responsible to the individual Service Chiefs. In order that all Services have senior representation, Deputy Chiefs are appointed from Services other than that of the Chief, AFSWP.

## The AFSWP Mission

The mission of AFSWP is to furnish support to the Army, Navy and Air Force in the field of atomic weapons by providing technical, logistical, and training services. To accomplish its mission, the AFSWP is organized with a headquarters in Washington D.C., and



its principal subordinate command at Sandia Base, Albuquerque, New Mexico. Headquarters, AFSWP participates in the complex activities of planning and coordination at Service level while Field Command, AFSWP is charged with field implementation of all AFSWP training, operational, logistical, and technical functions.

In the atomic weapons field, AFSWP acts as a centralized control for decentralized military operations. The success of AFSWP in performing its mission is aided in considerable measure by the multiple source of authority at the headquarters, since the policies by which it is guided are predicated upon coequal interest of each of the Services.

The following is a brief description of what AFSWP's mission involves in three of the four areas mentioned above:

**Logistics**—In accomplishing its responsibilities in logistics, AFSWP insures efficient planning and programming of special-weapons material and equipment, consolidates requirements of the Armed Forces, and assists in the performance of inspection and modification. AFSWP renders support on the operational level by publishing supply regulations governing accountability and handling of special-weapons material and equipment to supplement existing supply regulations; prepares special-weapons equipment lists and training allowances; procures and distributes initial, and resupply of, material and equipment as arranged between AFSWP and an individual Service; operates specialized facilities for calibration, repair and maintenance of special weapons equipment. Through logistic support activities, AFSWP contributes to uniformity of operational policies and procedures in the field.

**Training**—AFSWP was activated in 1947, along with the Atomic Energy Commission, as a result of the dissolution of the Manhattan Engineer District. At that time, AFSWP contained the only group of military personnel trained in the atomic-weapons field, and Service personnel were sent to AFSWP to receive technical training in the assembly, handling, storage, surveillance, maintenance, salvage and disposal of atomic weapons. The Services have since developed additional training programs of their own to meet increased requirements, and AFSWP has rendered continued assistance by preparing training programs for their use, by assisting the Service schools in preparation of instructional material, and by continuing individual and group training of Service personnel to supplement Service training programs.

Within AFSWP, training and assistance responsibilities in the atomic-weapons field are delegated to the Commander, Field Command, and are actually accomplished at Sandia Base under the direction of the Special Weapons Training Group. Here the most current information is utilized to insure that the individual to be trained develops a high degree of technical proficiency. Key officers of the Services are orientated in military application of atomic energy, and designated officers of the three Services are indoctrinated in the characteristics and effects of atomic weapons and in technical considerations essential to atomic weapons employment.

**Technical services**—The types of technical support which AFSWP renders are connected with less dramatic aspects of the atomic-weapons program, but they are no less significant. These technical services involve AFSWP responsibility for determining qualification, maintenance, proficiency, safety standards and physical procedures for all personnel and equipment involved in activities connected with the handling, transportation, inspection, testing and storage of atomic weapons and their components. The AFSWP is most fortunate in that it is staffed by its parent Armed Forces with highly talented technical and administrative personnel. From its military and civilian personnel, and from various consultants and panels, the AFSWP obtains the benefits of some of the best minds to assist in carrying out its mission. It is upon these individuals, these consultants and panels, and upon its liaison with the DOD, the Armed Forces, the AEC and other committees and agencies that the AFSWP relies to insure that no gaps exist in our knowledge in the field of atomic weapons. Through technical services, AFSWP insures that this fund of knowledge is passed on to the Armed Forces.

One of the more interesting types of technical service which AFSWP provides is in connection with field tests of atomic weapons or devices. AFSWP prepares preliminary plans and budget estimates for military phases of atomic weapons tests and coordinates and integrates Army, Navy and Air Force requirements for data obtainable through field tests. AFSWP is responsible for evaluating weapons-effects data and disseminates these evaluations to the Services and to other governmental agencies which have a need for this type information. In addition, AFSWP provides technical assistance to commanders of task forces concerned with atomic-weapons tests, and conducts a continuous review and analysis of test results from the scientific and phenomenological viewpoint.

## Weapons Effects

AFSWP is responsible for initiating studies and projects to insure that the needs of the Services in the fields of weapons effects and development of defensive measures against atomic weapons are met. Here, research con-

### About the Author

Rear Admiral Edward Nelson Parker, present Chief of the Armed Forces Special Weapons Project, graduated from the U.S. Naval Academy and was commissioned an ensign in 1925. He attained the rank of rear admiral on September 1, 1952.

During the period between 1925 and 1940 he served in assignments at sea and ashore, including instruction in general line, ordnance and gunnery. In World War II, he was awarded three Navy Crosses and the Silver Star for distinguished service and extraordinary achievement while serving with the Pacific Fleet.

In April 1947, after further service in the Pacific from 1945 to 1947, he joined the staff of Commander Marianas (at Guam), serving first as Logistics Officer and later as Chief of Staff. He was assigned in September 1948 to the Office of the Chief of Naval Operations, Navy Department, and served there until August 1950, when he assumed command of the Cruiser USS *Newport News*. In July 1951, he joined the staff of Commander Sixth Fleet as Chief of Staff. In September 1952, he became Deputy Chief of the Armed Forces Special Weapons Project, Washington, D.C., and served there until December 1954, after which he assumed command of Cruiser Division Six. On May 28, 1956, he reported as Special Assistant to the Deputy Chief of Naval Operations (Plans and Policy), Navy Department, and remained until June 1957, when he was ordered to duty as Chief of the Armed Forces Special Weapons Project.

tracts are initiated, and contact maintained with the Services, Government agencies or organizations and other organizations performing work in this field. In the divisions of this headquarters, data is collected, reviewed, analyzed and evaluated, and the results of this labor supplied to the users. Technical project proposals are reviewed and evaluated and integrated into an AFSWP-recommended program. This program is then presented to the three Services and the Assistant Secretary of Defense (Research and Engineering) for approval and implementation in full-scale tests. Indeed, the Radiation, Medical, Blast and Shock, and Analysis Divisions are engaged in the unending pursuit of new data, some of which may slightly, though significantly from the effects point of view, alter an effects curve; or other data which may lead to new fields and research.

Generally, effects test programs are tied in with the developmental tests whenever feasible for economy. However, in each test series it is usually necessary to detonate one or more devices whose characteristics are not subject to the degree of variation that devices incorporating new design features are. This is necessary in cases where the data must be obtained from a less variable source because it must be related to predictable phenomenon within the area of experimentation. Specific detonations are also required where it is considered desirable to study unexpected effects which may have been detected in a former detonation, or where uncertainty of behavior under environmental changes indicates additional studies are required.

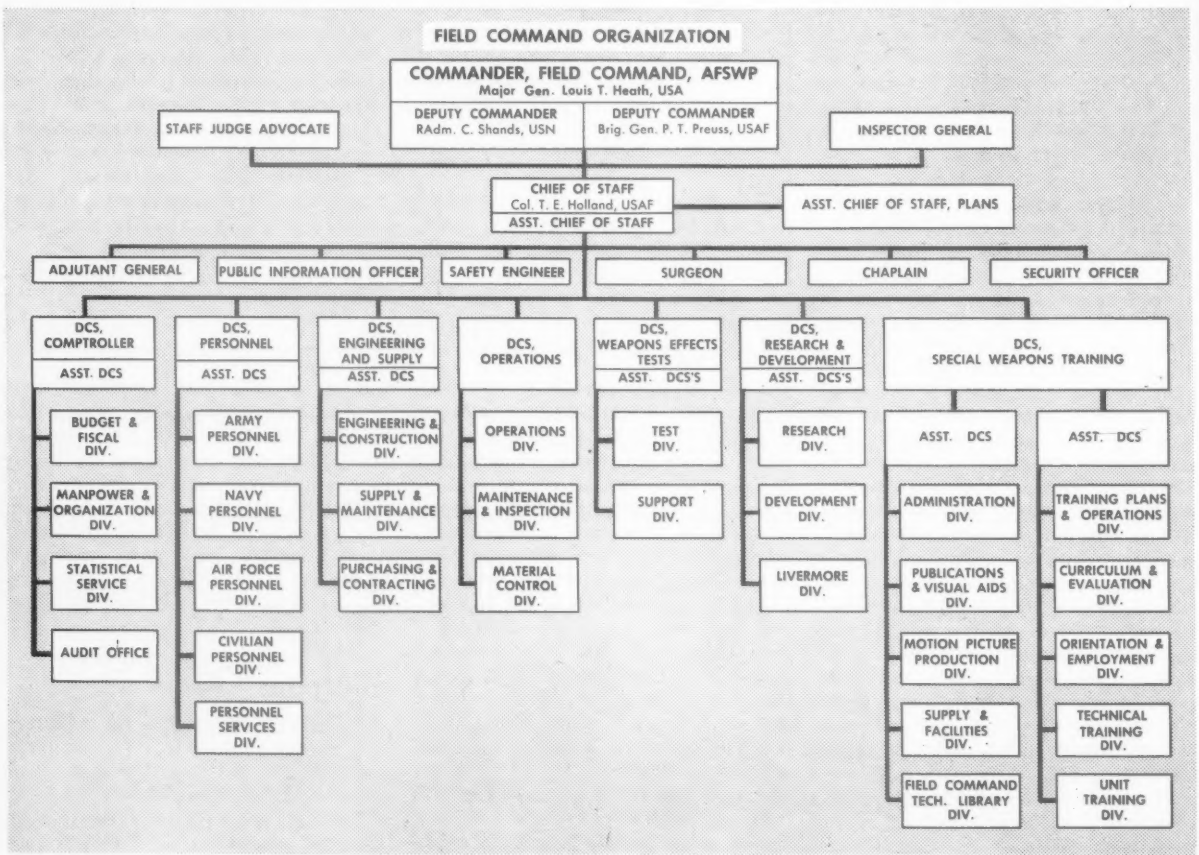
AFSWP personnel continuously review full-scale test reports and other publications concerning the effects of nuclear weapons—blast, thermal and nuclear radiation and fallout. AFSWP initiates, coordinates and supports research on these effects to supplement and complement the full-scale tests, and maintains liaison with the Atomic Energy Commission, the Services, and other interested agencies engaged in research related to these problems.

## Weapon Test

The AFSWP is responsible for overall coordination, processing and administration of the preliminary phases of each weapons-test program. There never has been a period of relative inactivity. Since the inception of AFSWP it has been always in the process of, or in the planning for, a test series —and usually both.

The AFSWP advises the Services of test schedules and obtains participation in the form of weapons-effects and operation and training-project proposals, and coordinates these projects for implementation at full-scale weapons tests. It coordinates requirements for military assistance in support of the AEC in the conduct of the field tests. AFSWP plans for, administers and supervises projects and special studies not related to DOD participation in test series, and maintains working-level liaison with representatives of the organizations and activities engaged in work on these particular projects and studies. In addition to the functions indicated, the AFSWP is responsible for preparing budgets for research and development and extramilitary expense requirements for future atomic tests. It monitors current budgets for tests, and has the additional responsibilities for functional accounting for current and future tests.

While this headquarters is responsible for all of the aspects of nuclear testing, planning, preparation and implementation, at an appropriate time the actual implementation is transferred to the AFSWP activity most actively engaged in the actual tests—the Field Command, Armed Forces Special Weapons Project.



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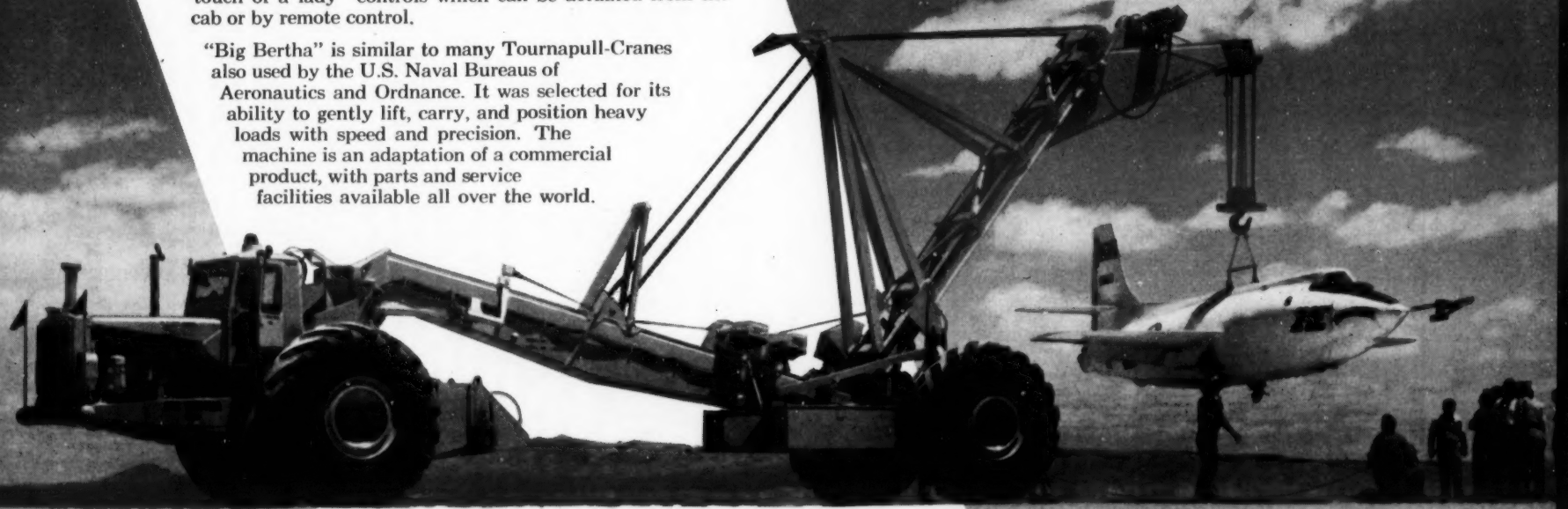

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# Washington Background

**ARMY GENERAL GAVIN'S** retirement from the field has left Pentagon gossips in a tizzy. They had picked him as most likely to succeed Maxwell Taylor (whose tour is up 1 July 1959) as Army Chief of Staff. Now they don't know where to turn. Their so-called best choices in this perennial guessing game (among them: Lemnitzer, Eddleman, "Hammerin' Hank" Hodes) are either retiring or reportedly out of favor with the men who can put them into the job. One man now picking up votes fast in the "corridor primaries" is General George H. Decker, commander of UN Forces in the Far East.

Sidelight on Taylor: unless he slows down, he may not even finish his tour. With startling regularity in past months, a report has floated around the Pentagon, neither confirmed nor denied, that his doctor has been ordering him to slow down to fight off constantly recurring illness—an indication his health is not what it should be.

**THE CIVIL AERONAUTICS BOARD** is likely to rewrite its regulations governing military charters and contracts. If they do, commercial airline claims that they can service the Department of Defense cheaper and better than MATS are going to lose some of their punch. Reason: DOD is only big-time customer of airlines which can buy transportation at lower than published tariffs. Recent trends indicate some airline service to DOD may be offered for little more than gasoline cost. New CAB rules will do away with this. Net result: cost to Government of shipping via commercial airlines will go up, even if DOD keeps business with airlines at present level.

**THE MILITARY IS MISSING** a good bet in its present crash program to speed up dissemination of information to its scientists. An ever-growing mass of people is engaged, right now, in culling stacks of science literature, attempting to spread it out to the research groups—mainly to answer an R&D complaint that communication on new ideas, techniques, etc., is poor. The Bureau of Standards in Washington has an electronic machine which reportedly will do the same job in seconds with a minute fraction of the people involved.

**WE MAY SEE** a repeat of the Sputnik hysteria in the field of atomic aircraft. The stage is all set, needs only Russian flight of an atomic aircraft to light the fuze. Here are the players:

1—Congress, which refuses to ease up on its demand for a "fly-early" atomic aircraft.

2—The Air Force, which has said it can get an atomic reactor aloft on an existing airframe—but because of present state of development, it would have less than no military value.

3—The President, who has taken the practical, but unpopular, stand that he does not want to divert materials and talent away from efforts to produce a fully atomic military aircraft.

The scene is almost identical to the presatellite era, when the military were working for an operational ICBM, knowing, if they solved this problem, a satellite shoot would be relatively simple. Their only error: not allowing for the emotional reaction of an uninformed public.

**SPEAKING OF SATELLITES.** Look for a more favorable reaction to the test firings going on at Cape Canaveral, not because the tests are suddenly any more "successful" (General Donald Yates, who commands the test center, told a press briefing recently he could recall only three tests in the last two years which, from a research standpoint, were not successful—none of them the headline makers), but simply because the Pentagon has relaxed the strangle hold it held on what the test center could say about its firings. Instead of the conjecture which has been passed off on the public as fact, the press is going to be better informed—and the real story of what has been going on down there is one any military citizen can be proud of.

**HOUSE GOVERNMENT INFORMATION** subcommittee will release a report, probably this month, on Pentagon information policies which, it is reported, will say bureaucratic refusal to exchange information between services has hampered defense efforts.

## Armed Forces Day: Good or Bad?

In 1957, Armed Forces Day had a direct impact on more than 21 million people in the U.S. and abroad. Another 50 million watched on television.

It has a slogan: Power for Peace; a date: May 17 this year (but it will run May 10-18); and is, basically, a Department of Defense public-relations idea to let the taxpayer see, first hand, a small chunk of the hardware he buys.

It has been going on since 1950 (when DOD, as a symbol of "service unification," consolidated the separate one-day service celebrations into this single affair) and, after eight sessions, no one has yet determined whether it is really good public relations or not. There is a growing feeling among the military men who actually run the show that *it is not.*

The best that has ever been said for it is the "Well, why not?" idea that it is "probably a good thing."

Those who could point out what is wrong (the men who fill requests for a band here, a display there, an airplane somewhere else) have not been very outspoken, probably because they very justifiably feel it's not worth risking a promotion for. But their off-the-record comments to some of the reasons for Armed Forces Day make interesting reading. Here are a few:

**AFD gives the Services an annual "day in the Sun."**

Each service had this long before AFD, when each had its own "day."

**It gives the public an annual report on the state of the Nation's defense forces.**

The Military makes the front page of nearly every newspaper nearly everyday, and it is hard to see how an annual parade is going to improve on this report.

**It creates good will for the Services.**

If Chicago, St. Louis, Detroit, Cleveland, and Slippery Rock all ask the Tenth Air Force Band to keynote their celebration, are the other four going to be happy if St. Louis gets the nod? This situation has cropped up several times already this year—in fact, hundreds of times if you count the "fly-over" requests from local competing politicians trying to impress voters.

**It brings the local community closer to the local installation.**

The observance is essentially a local "open house." The local installation will have better success if it gears its program to some local civic celebration, the best local weather report, etc.

**A single observance is cheaper.**

Having only one celebration does not mean there is necessarily any less activity.

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# • electric controls
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Compare tires to crawler tracks, for example. Four tires (2′ wide, 5½′ tall) do the work of 450 to 550 wearing parts in a track assembly. Flexing tires clean themselves, provide ground-gripping traction. Rigid tracks and grousers, on the other hand, clog up with mud and abrasive grit, need extensive cleaning often. Low-pressure tires also act as big shock absorbers, reducing shock and damage from vibration.

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# Research and Development

## WSPG To Grow

**Prospects for the future** in the **White Sands Proving Grounds, N.M.,** area contrast sharply with the general state of the Nation, where unemployment, cutbacks in production and reduced spending have brought a recession scare.

Latest figures on WSPG personnel strength, payroll, construction and proposed expansion indicate the range will have 20,000 workers, a $70-million annual payroll by 1960.

The Cape Canaveral Test Center faces the same growth prospect, plans to increase its population from 15,000 to 18,000 by year-end. Canaveral is now in the midst of a building program for the Martin Titan ICBM and the Polaris. And, said one Canaveral spokesman, "If people don't quit running into the Pentagon with new moonshot ideas under their arm every day, we may never be through building."

## Manned Rocket To Girdle Globe

**Proposed "slingshot launching"** of a manned, globe-girdling hypersonic **rocket glider** capable of outdistancing intercontinental ballistic missiles was outlined in late March by a **Ryan Aeronautical** engineer as a highlight of a secret three-day symposium on high-speed aerodynamics and structures.

The paper on piloted long-range rocket gliders, traveling at near-satellite speeds and designed to travel around the world and return to their original destination while exploring space, was submitted by Vjekoslav Gradecak, Yugoslavian-born Ryan structures engineer.

Ryan's recently developed **"Mini-Wate"** method of fabricating a paper-thin, lightweight, high-strength steel alloy may provide the structural means by which the rocket glider could resist the tremendous friction heat generated in ascent and re-entry into the dense atmosphere, Gradecak explained.

Concept of Ryan manned rocket.

## Nuclear Programs Streamlined

**Research and development** effort in the area of **nuclear propulsion** has been streamlined and expanded by the **Air Research and Development Command.**

A new office at Andrews AFB has superseded the Directorate of Nuclear Systems at Dayton. It will be headed by **Col. John H. DeRussey,** Assistant for Nuclear Systems.

The new program includes not only the WS-125A nuclear bomber but end-product hardware, nuclear-powered ramjets, rockets, satellites and even space travel. ARDC sees special benefit for contractors and subcontractors in the new setup.

Col. DeRussey said, "Our office serves as a central point of contact for contractors. We feel it will eliminate much past duplication and wasted motion." He added: "A definite and positive benefit to industry accrues from our new setup. Formerly funding was a problem. Contractors didn't even know from how many sources their money came. As a result, a continuing battle of the budget was waged. We now have a single money package. We're a clearing house for funding all nuclear programs for ARDC."

## Polaris Ahead Of Schedule

**The Navy's Polaris** fleet ballistic missile is running more than a **year ahead** of a top-priority development schedule, thanks to a streamlined **Manhattan-Project-type** Navy special projects organization, and the efforts of a well knit industrial and scientific team, reported **RAdm. W. F. Raborn** recently.

As head of the project, he repeated a prediction that the missile will be in the fleet by 1960, and said also, "All phases of Polaris development are making such phenomenally good progress that our greatest fear is overconfidence. Largely because of the harmonious cooperation of our industrial team—Lockheed, Westinghouse, Aerojet-General, General Electric, Sperry—and because of a new planning concept, we expect the Polaris will be one of the most economical of the major-deterrent mass-destruction weapon systems."

## Irvine Mentions "Dynasoar" Project

**Lt. Gen. C. S. Irvine,** Air Force Deputy Chief of Staff (Materiel), voiced the code name **"Dynasoar"** for an important manned space-vehicle project —probably using the boost-glide technique—late last month to the **Western Space Age Conference.**

Irvine said the air-space craft will be controllable from orbital altitudes down to well within the atmosphere, and the final stage will proceed to the designated landing base. Much of the basic information for the project has been gathered by a team headed by Bell Aircraft, which reportedly has gone far enough to test some of the actual hardware which would be used.

However, proposals are pending from teams composed of almost all the principal aircraft companies and experts in major subsystems involved. Best guess is that if everything goes as planned, a design contract may be provided before the end of the calendar year.

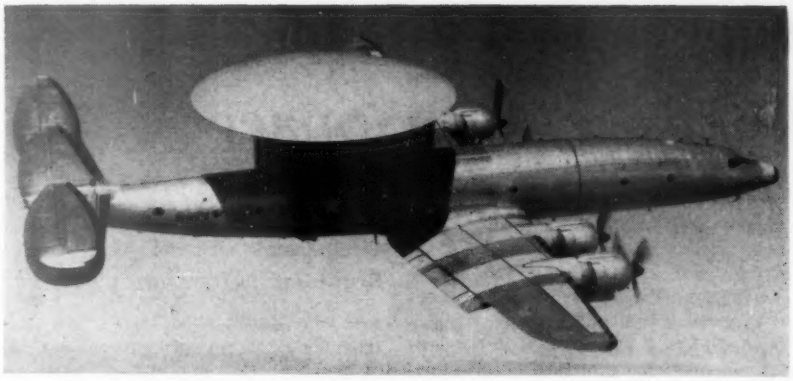
## Navy Develops Data Technique

**A new achievement** which would permit physiological information to be transmitted over long distances by radio or telephone has been developed at the **Naval Medical Research Institute** in Bethesda, Md.

Such information as heartbeat, breath sound, spoken words and other measurements of the physical condition of humans or animals can be transmitted from isolated areas to Bethesda. Obviously, this system will go far in making it possible to obtain the measurements of the physical condition of animal and human occupants of future space vehicles.

## York Named To ARPA Post

**The Institute of Defense Analyses (IDA),** a nonprofit corporation which provides scientific and technical services for the Defense Department and Joint Chiefs of Staff, has announced that, at the request of Defense Secretary Neil McElroy, it has established an **Advanced Research Projects Div.** to perform technical studies for the



**Flying Saucer—Strangest looking shape in the sky, U.S. Navy "flying saucer" radar research airplane is shown in flight from South Weymouth Naval Air Station, Mass., in program aimed at sharp advancement in America's airborne early-warning capabilities.**

Defense Department's new Advanced Research Projects Agency. **Dr. Herbert F. York,** presently Director of the Atomic Energy Commission's Livermore, Calif., laboratory, is being given a leave of absence to head the new IDA division. He will serve as Chief Scientist of ARPA under Director Roy W. Johnson.

## Boeing Shifts

**According to Boeing Magazine,** major shifts of responsibility in Boeing **top management** were made recently to speed technical research and the development of new vehicles suitable for high-speed flight in the earth's atmosphere and in space. The company, in addition to personnel shifts, plans to establish a basic research organization, to be known as **Boeing Scientific Research Laboratories.**

## 2nd Conrad Award To Dr. Lauritsen

**The second annual Captain Robert Dexter Conrad award,** established by the Office of Naval Research, was presented in March to **Dr. Charles C. Lauritsen,** professor of physics, California Institute of Technology.

The award is made in recognition of and reward for outstanding technical and scientific achievements in research and development for the Navy. Named for the primary architect of the Navy's basic research program, it was awarded to Lauritsen as an outstanding contributor to the Navy's rocket program (among most experts in the field he is known as "father of Navy rocket power").

## Missile Detection Steps Forward

Under an Army Ordnance research contract, the **Cornell Aeronautical Laboratory** recently transmitted radar-like signals many times more powerful than previously believed possible—a significant step forward in detection apparatus for the ICBM.

The peak power of 21,000,000 watts, said to be the largest peak power ever radiated, was reached by use of a special microwave generator.

## Army Measuring Upper Air

**Army scientists** are conducting tests, using rockets which release **metallic confetti** more than 50 miles above the earth, to plot **winds** in the **upper atmosphere.** Purpose of these tests is to provide accurate information on wind behavior at high altitudes—necessary for delivery of an intercontinental ballistic missile on target and for developing new weather-forecasting theories.

## Fire-fighting Suit Under Test

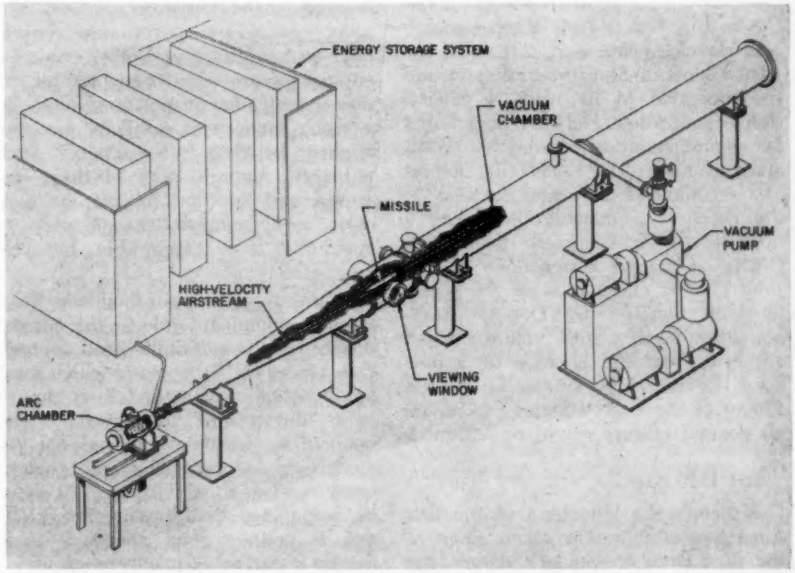
**Intensive testing** of the **Army Quartermaster Corps'** new expandible aluminized **fire-fighter's suit** took place in late March by foresters facing a 500-acre underbrush blaze near Laurel, Miss.

Tested for possible adoption by Forest Service fire fighters, the suit is styled much like the Arctic parka and sized to fit over a duty uniform, steel helmet and breathing apparatus.

## Step-up Due In Missile Testing

**A big step-up in missile testing** is scheduled as soon as instrumentation is installed which will permit **simultaneous countdowns** for more than one missile test at a time at the Air Force Missile Test Center on **Cape Canaveral.**

Plans are to set up for a capability of as many as three firings at the same time. Hoped for some time this year, exactly when, the Test Center could not say.




**Speeds up to 15,000 miles an hour and temperatures hotter than the sun's surface will be reproduced in this "hotshot" wind tunnel now being built at Lockheed Missile Systems Division's research laboratory in Palo Alto, Calif. The 44-foot-long tunnel, designed to simulate conditions encountered by a high-speed missile flight through the Earth's atmosphere, will be the fastest wind tunnel in use by private industry. Compressed gas in arc chamber, left, will be fired by 20-million-kw jolt of electricity from 320 condenser-unit energy storage system, stacked in adjoining room. Gas will be heated instantly to 18,000°F, causing it to erupt through a diaphragm. Superheated air will explode through the tunnel, which has been evacuated by vacuum pump, and blast against nose of test missile.**

# Bureaucratic Patterns and the Race Into Space

by Charles W. Shepard, *Colonel, USAF*
and
Rufus C. Browning, *Ph.D., TAGO, DA*

***The purpose of this article is to look behind the scenes of the management of our Armed Forces; to analyze the significant role which bureaucratic organization plays in shaping and controlling the military strength of the nation. An understanding of organization and techniques which permeate our whole system will give greater insight into the observations, criticisms and proposed cures which are daily finding their way into print.***

THE date the Soviet Union launched its first Sputnik has special interest for all those associated in the management of our Armed Forces. Interest in a shakeup in the top echelons of our defense organization is widespread. Evidence is abundant of an impending change in the U.S. military structure. The stage has been set by a policy statement from the highest authority: President Eisenhower publicly announced that reorganization was necessary. Lieutenant General James Gavin, the Army's former top research and development man, attacked the Joint Chiefs of Staff establishment and recommended in its place a general staff organization. He later punctuated his recommendation with his retirement announcement. The Rockefeller Report has recommended drastic revision in the defense organization, including a new role for the Chairman of the Joint Chiefs as actual commander of the Joint Chiefs, designation of the Secretary of Defense as Deputy Commander-in-Chief with more direct authority, and the creation of a new single-service to be known as "Armed Forces of the United States," to which all general officers would be assigned.

## The Blame

Although the launching of the first American satellite has taken some of the sting from the Soviet's victory, the trend of the American press is to pin the blame on someone for allowing the USSR to take the apparent lead in the missile field. There are strong arguments heard concerning the fact that we simply are not properly organized to do the job, that the services are in competition with one another and that no single entity is really responsible for the success of the entire program. The questions of responsibility and control are vital ones in a bureaucratic structure.

Carl J. Friedrich of Harvard University was concerned with the importance of this subject when he wrote: "The decisive problem is whether the bureaucracy is 'responsible.' How to make it so is the real issue, and many of the most insistent problems of industrial society revolve around this issue, not only in government, but in large-scale industry and other economic enterprises as well. As an administrative organization grows in size, an increasing amount of publicity can and ought to be given to its activities. Such publicity, though often bitterly resented and opposed by the bureaucracy, really contributes not only to making it more responsible, but also more effective."

What is bureaucracy and why does it play a dominant role in the current debate over responsibility and control? One aspect of bureaucracy which must be disposed of immediately is that it is a "dirty word" employed to denounce or criticize officialdom in modern society, especially the government service or civil service. It must be recognized that bureaucracy in itself is neither good nor bad—it is merely a method of management which can be applied in different spheres of human activity. In its application to the Armed Forces it can be shown that there are advantages and disadvantages, but one should avoid the preconceived idea that it is, *per se*, an evil.

The dictionary tells us that bureaucracy is a form of government administered by departments and subdepartments, each under a chief responsible to higher authority, and operating with a highly systematized routine. The term is used in the setting of the Armed Forces to describe a system which includes the organization—both formal and informal—and the complex of people who make it operate.

## Size

It has been aptly put that the curse of bigness lies in the administrative difficulties that it imposes. There is a direct relationship between size and the bureaucratic tendencies of an institution. The larger an organization becomes the more pronounced are the features of inflexibility and impersonality. Examples of this fact are abundant in the Armed Forces. The real issue is whether or not inflexibility and impersonality affect the responsibility and general efficiency of management. At one end of the scale are the small primary groups which operate on a face-to-face basis without the requirement for bureaucratic organization. At the other end of the scale are the intricate and complicated organizations we find at the top levels of each of the military services, the joint arrangements and the unification processes. The sheer size of these certainly is a heavily weighted, influencing factor in determining their organization and functions. And within this size is a diminished capability for retaining responsibility and control as successive echelons are brought to bear on a situation.

The existence of successive echelons in the military organization has created more interest than any other phase of its bureaucratic functioning. One sees a multitude of levels in the hierarchical arrangement, including multiple levels in each operating echelon. These become magnified and more complex when it is understood that there are really two systems operating in each of the levels. Actually, to understand the system, one must realize that there

is an informal as well as a formal organization in operation. That an organization has charts and a list of functions which describe exactly how an organization is to run, does not mean that it is run in that manner. Many times operation succeeds seemingly in spite of the elaborate formal organization rather than because of it.

Formal organization is characterized by the military fetish for organizational charts, job descriptions, finely drawn lines of responsibility, etc. Equally well understood by military men are the ways to circumvent the formal organization and get the job done. Informal organization starts when you hang names on a chart. Here is where interpersonal relationships begin, and these preclude the possibility of thinking of the organization in a purely abstract sense. One sociologist has said: "Informal organizations are found within all formal organizations, the latter being essential to order and consistency, the former to vitality."

When the bureaucratic organization evolves into informal patterns, the factors of responsibility and control are affected and do not operate as they might in a theoretical sense. In her study of an actual group composed mainly of scientists, engineers and technicians, Paula Brown points out: "As issues arise and problems change, there are different alignments of individuals and groups, on the basis of different subgroups, past associations, personal goals, group goals and individual attitudes toward the issues themselves. Thus identification with the department as a whole is less frequent than identification with one of its subgroups. Furthermore, the people who exercise influence often stimulate small group loyalty rather than identification with the department or station."

It should be understood that the informal organization refers both to the informal groupings of people (as contrasted to the formal organization on the chart) and to the informal "system" which operates over and above the official lines of responsibility. Military men are well acquainted with the informal systems: how to get the recreation room painted when there are no funds or materials available; how to get a service performed by "going in the back door" rather than going through the laborious formal channels. This is what C. H. Page calls the "channels of circumvention of the formally prescribed rules and methods of procedure." In his analysis of his war years in the Navy, Page further points out that "bureaucratic structure requires public sanctification of the formal procedure and private sanctification of the informal."

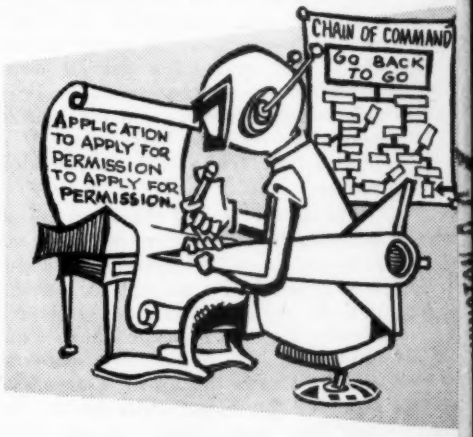
In any large-scale operation it is normal and logical to have a formal pattern of management structure. There are advantages and disadvantages to the formal structure, but the hard facts would indicate that there is little choice in the matter. That is, when an organization assumes size to a degree that individual and personal management no longer work, a bureaucratic pattern develops. The advantages are quite apparent, all military men being familiar with one of the primary rules first learned—a group without organization and leadership is nothing but a mob. This advantage is underscored by Merton, who wrote: "The chief merit of bureaucracy is its technical efficiency, with a premium placed on precision, speed, expert control, continuity, discretion and optimal returns on input. The structure is one which approaches the complete elimination of personalized relationships and nonrational consideration (hostilities, anxieties, affectual involvements, etc.)."

## Disadvantages

Because the operation of a bureaucratic system eventually must result in the participation of men, certain disadvantages arise. When a ruling clique operates it can impose its own interests, rather than stress the success of the organization. This disadvantage is not often observed in the military, perhaps being offset by the normal turnover of personnel, Inspector General systems and other checks and balances which prevent the authority of minorities getting out of hand for any extended period. Theoretically, however, this clique situation can very well lead to the misuse of control and the improper exercise of responsibility. The civilian staffs within the Armed Forces, lacking some of the controls which uniformed personnel have, also pose a possible threat in this respect.

Another disadvantage of bureaucracy frequently mentioned is the tendency of the organization to let the means become the end. The people functioning in the formal organization become so involved with the externals that they lose sight of the true purpose and objective of the task; they concentrate on the nonessentials to the point of decreasing effectiveness. Close order drill is a typical example of this phenomenon; so is the meticulous regard of uncorrected typewritten copy, even with the typist shortages being what they are; so is the administrative officer who pays unswerving allegiance to the regulations as he nullifies a perfectly logical action because it is not in accordance with them. Even when completely right, you will override only with difficulty a person armed with a directive or regulation which prohibits a certain action. When logic and regulation conflict in the military, almost certainly the regulation will prevail.

Specialization is a characteristic of bureaucratic structure, tending to result in narrow and restrictive job competencies and functions. Few will deny the gains in efficiency and economy which can result from specialization. We must recognize, however, that it may create problems in the field of personal relationships. It has been reported that a group of specialists under study in a government laboratory did not always fit into a narrow slot; rather, "as a privileged professional group, they felt they should have authority to make decisions about the internal organization of the department and should participate in policy decisions concerning group objectives."




As specialization grows, this area may loom larger as a problem situation for the military.

Other characteristics of the military structure are the existence of insularity and stratification and the possible development of self-centered organizations. If we consider the officer corps as equated to the executive in business or industry, we find an immediate stratification distinction between the officer and the enlisted man and also in the very positive levels among the officer corps by virtue of the rank structure.

The insular traits of officers and the self-centered organization of the military apparently are well recognized. The quality is stressed by Page in describing the "in-group" loyalty of Navy Regulars and their intense disassociation with the "out-groups," such as the reserves and civilians. A. K. Davis has stated that "the Navy is an insulated occupation" and that insulation "can be found in all bureaucratic organizations; and it is especially prominent in military bureaucracies." Insulation and stratification may promote

responsibility and control in some instances, but they may also reduce efficiency of operation by virtue of placing differing judgments on actions, depending upon the personnel involved in a given situation.

## Advantages

On the positive side of the picture, Merton made a meaningful statement when he said: "If the bureaucracy is to operate successfully, it must attain a high degree of reliability of behavior and unusual degree of conformity with prescribed patterns of action. Hence, the fundamental in importance is discipline, which may be as highly developed in a religious or economic bureaucracy as in the Army. Discipline can be effective only if the ideal patterns are buttressed by strong sentiments which entail devotion to one's duties, a keen sense of the limitations of one's authority and competence, and methodical performance of routine activities." This suggests a general compatibility of military operation and bureaucratic structure and the reasons why the military have adopted a bureaucratic frame with considerable success.

Taking the several characteristics of bureaucratic management into account, it is easy to see that there are sufficient weaknesses in its concept to warrant periodic review of military structure. Clearly, the most dramatic influence for change in the bureaucratic patterns now existing in the Armed Forces is a result of the Soviet challenge in the race into space. One can see how things can get "bogged down," how control and responsibility are weakened. Particularly, it can be seen how a decision, or lack of a decision, can have an all-powerful effect on an important operation. Under bureaucratic management a recalcitrant person or group, rightly or wrongly, can hinder progress toward an overall goal. When Sputnik I was orbited there was a tremendous cry to find out why the Free World with its talents and materials could not have been first to achieve this feat.

Under these circumstances it was quite logical to look at the total organization and to conclude that a change was in order. The organization which was being examined was bureaucratic and possessed all of the strengths and weaknesses of this form of organization. The task of those responsible for reorganization is to eliminate those features which can be identified as inefficient, and to redesign a system which can handle sizeable military forces and, at the same time, be effectively coordinated with all other agencies having an interest in our national defense.

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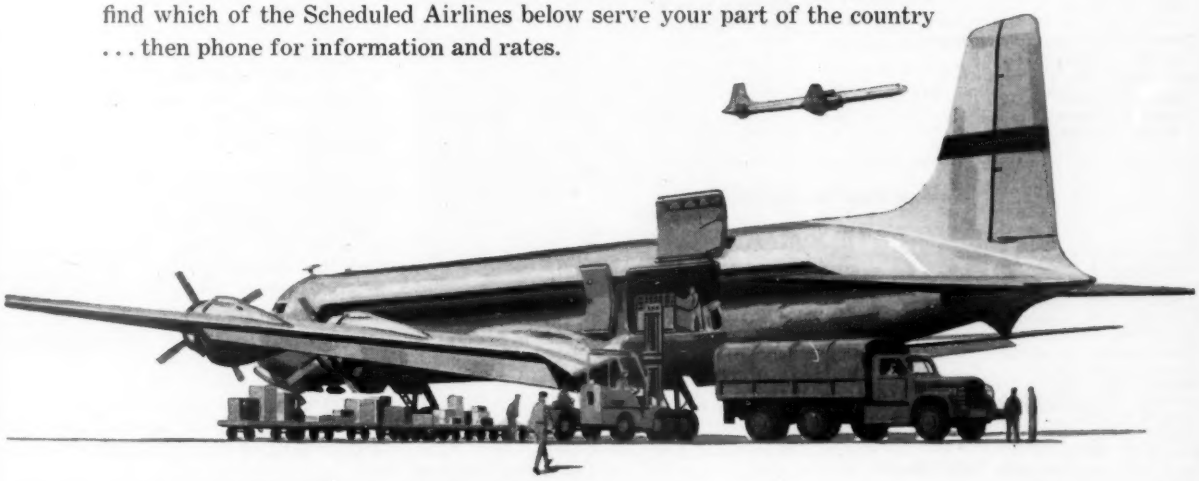

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Engineer, Fire Control Design GS-9, 11
Engineer, Electrical GS-9, 11
Engineer, Electronic GS-9, 11
Engineer, Mechanical GS-9, 11
Physicist GS-9, 11
Scientist, Electronic (Instrumentation) GS-9, 11

**Industrial Relations Office**
**U.S. Naval Aviation Ordnance Test Station**
**Chincoteague, Virginia**
Engineer, Electrical GS-9 to 11
Engineer, Electronic GS-9 to 11
Engineer, Mechanical GS-9 to 11
Engineer, Ordnance GS-9 to 11

**Industrial Relations Office**
**U.S. Naval Training Device Center**
**Port Washington, New York**
Designer, Training Aids and Devices GS-11
Engineer, Aeronautical GS-9, 11, 12
Engineer, Electronic GS-9, 11, 12
Scientist, Electronic GS-12

**Industrial Relations Officer**
**U.S. Naval Supply Depot Bayonne**
**Brooklyn Annex**
**Brooklyn 32, New York**
Officer, Information (General) GS-9

**Commanding Officer**
**Navy Electro-Standards Agency**
**Fort Monmouth, New Jersey**
Engineer, Electronic GS-9, 11, 12

**Industrial Relations Officer**
**U.S. Naval Avionics Facility**
**Indianapolis 18, Indiana**
Fire Control Design Engineer GS-9
Fire Control Design Engineer GS-11
Electronic Engineer GS-9
Electronic Engineer GS-11
Mechanical Engineer GS-9
Mechanical Engineer GS-11
Electrical Engineer GS-9
Electrical Engineer GS-11
Electronic Scientist GS-9
Electronic Scientist GS-11
Physicist GS-9
Physicist GS-11

**Industrial Relations Department**
**U.S. Naval Repair Facility**
**San Diego 36, California**
General Engineer GS-11
Materials Engineer GS-9
Marine Engineer GS-9
Naval Architect GS-11
Mechanical Engineer GS-9
Mechanical Engineer GS-11

**Employment Section**
**Room 1003, Main Navy Building**
**Washington 25, D.C.**
Digital Computer Systems Specialist GS-9 or 11
Military Installations Planner (City Planner) GS-13
Aeronautical Power Plant Development Engineer GS-11 or 12
Aircraft Engine Inspector GS-13
Aircraft Inspector (Electronics) GS-13
Construction Management Engineer (Airfields) GS-11 or 12
Electronic Engineer GS-11 or 12
Electronic Engineer (Radio) GS-13
General Engineer GS-11
Marine Engineer GS-11
Ordnance Engineer GS-11
Power Plant Development Engineer GS-9, 11 or 12
Structural Engineer (Buildings) GS-9

POSITIONS REQUIRING PERMANENT CIVIL SERVICE STATUS
Civil Engineer (Soil Mech & Pav) GS-12
General Engineer (Logistics and Facilities) GS-11
Industrial Engineer GS-12
Accountant, Supervisory (Director, Accounting Div.) GS-14
Digital Computer System Specialist (Supervisory) GS-13
Education Specialist (Male, Vet.) GS-11

**Navy Overseas Employment Office**
**U.S. Naval Gun Factory,**
**Administration Building**
**Washington 25, D.C.**
Engineer, Mechanical, Newfoundland GS-11 *$622
Specialist, Facilities Maintenance (Status), Spain GS-10 **$493
Assistant, Supervisory Fiscal Accounting (Male-Status), Cuba GS-9 *$453
Engineer, Electrical, Cuba GS-9 *$510
* Plus Quarters
** Plus Quarters Allowance

**Navy Overseas Employment Office**
**45 Hyde Street**
**San Francisco 2, Calif.**
Engineer, Electronics, Guam GS-13, $839
Engineer, Electronics, Guam GS-11, $622
Engineer, Industrial, Guam GS-11, $622
Engineer, General, Guam GS-9, $510
NOTE: Add 25% to salary for GS positions on Guam.

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**DEPARTMENT OF THE AIR FORCE**

*** U.S. VACANCIES**

| | |
|---|---|
| Aeronautical Engineer (Structural) GS-11 | Kelly AFB, Texas |
| Aeronautical Engineer (Gas Turbine Power Pl) GS-11 | " " " |
| Aeronautical Engr. (Reciprocating Power Plant) GS-11 | " " " |
| Electrical Engr. (Aircraft) GS-11 | " " " |
| Electronic Engr. (Aircraft) GS-11 | Pease AFB, N.H. |
| Management Analyst GS-11 | Robins AFB, Ga. |
| Electronic Engr. (Gen) GS-11 & 13 | " " " |
| Chemical Engr. GS-13 | " " " |
| Industrial Engr GS-11 | " " " |
| Electronic Technician GS-11 | " " " |
| Physicist GS-11 | " " " |
| Chemist GS-11 | " " " |
| Metallurgist GS-11 | Lockbourne AFB, Ohio |
| Supervisory Electrical Engr. (Gen) GS-13 | McConnel AFB, Kans. |
| General Engineer GS-9 & 11 | Offutt AFB, Nebr. |
| Digital Computer Programmer GS-11 | " " " |
| Mechanical Engineer GS-11 | " " " |
| Meteorologist GS-11 | " " " |
| Electrical Engineer GS-11 | Olmsted AFB, Pa. |
| Airc. Mod. Design Engineer GS-11 | " " " |
| Elect. Engr. (Radio) GS-11 | " " " |
| Elect. Engr. (Wire Comm) GS-11 | " " " |
| Industrial Engr. GS-11 | |

**** OVERSEA VACANCIES**

| | |
|---|---|
| Structural Engineer GS-11 | England |
| Supv. Mechanical Engr. GS-11 | Alaska |
| Electrical Engr. (Wire Comm) GS-11 | Alaska |
| Electrical Engr. GS-11 | Alaska |
| Electrical Engr. GS-11 | Newfoundland |

* Applicants apply direct to base where vacancy exists.
** Apply to any Air Force installation.

## Army Research Change Possible

The Army's selection of the Martin Company as systems contractor for its new solid-propellant Pershing Missile System may be an indication it is planning to make greater use of industry in new weapons research.

Until now, the Army, on most projects, has done a big share of its own research work, giving industry a production contract only after the job was fairly well down the line.

With the Pershing, Martin will be responsible for research and development, reliability testing and production not only of the missile itself, but of the associated ground equipment, and will furnish ancillary services such as engineering, maintenance, training and field service. In essence, this is borrowing a page from the Air Force book. AF, for some time, has given industry a project from start to finish, has relied almost completely on private enterprise to furnish the answers.

If Pershing is a reliable example, this new setup is going to mean more work, and more money, for industry. The program will involve several million dollars immediately and is expected to amount to a multimillion-dollar program over the next few years.

## Missile Standards Committee Set

The Department of Defense has set up a standardization committee to work with guided missiles. The committee will develop and recommend missile standardization plans for the Assistant Secretary of Defense for Supply and Logistics.

Chaired by a representative from that office, the committee is composed of representatives for the services and from the office of the Assistant Secretary for Research and Engineering. The committee will act as an industry liaison, and one of its first jobs will be a review of existing standardization programs.

## MATS Inquiry To Start This Month

**A special Senate Commerce Subcommittee** established to investigate Government competition with commercial air carriers is scheduled to start hearings April 16 with **Senator Warren G. Magnuson** (D-Wash.) as chairman.

Officials of the **Military Air Transport Service** will be called first to answer what Magnuson said were "many complaints that MATS flies certain domestic routes regularly in competition with government-regulated private carriers."

## *This Month:* Dr. George E. Valley

**Chief Scientist, USAF**

FORTY-FOUR-year-old Doctor (of physics) George E. Valley said, in *Fortune* magazine, "It would be a good thing if all the service chiefs and all the higher-ups in the Defense Department had advisers who were leaders in science and whom they could get to know personally and trust."

Basically, Dr. Valley was talking about his own job, and, just as basically, he feels the Pentagon should have more like it. He thinks that the boards, panels and committees currently advising the Defense Department are composed of men of superior wisdom and experience, evidenced by their heavy private responsibilities. But in private life these men have intimate knowledge of their private projects and organizations; serving the Defense Department only one or two days a month, they can't get a similarly intimate knowledge of public affairs. Dr. Valley thinks wise men are most effective when their wisdom is reinforced by the broadest possible knowledge of what is going on; that is why he would like to see 40 or 50 of the present advisers work full time in the Pentagon for a year. He thinks each of them could give more useful advice in a day on a man-to-man basis than can be obtained from the often conflicting committee reports which few have time to read.

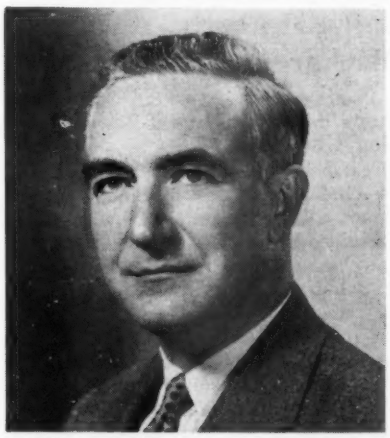
Valley says he isn't in favor of abolishing all the committees, but he feels that those which function like the Air Force's Scientific Advisory Board are most effective. These are the committees the members of which understand the limitations of periodic consultation, and who emphasize mostly broad policy questions; or which set up *ad hoc* working subgroups to study, *full time,* some detailed matter of interest.

About halfway through a one-year leave of absence from his job as physics professor at the Massachusetts Institute of Technology, Valley says he does not attempt to cover the entire Air Force R&D program because, "I couldn't accomplish a thing," instead hits only a "small area of my particular interest." It just so happens that this small area, if his background is any indication, is one vital to Air Force research.

Armed with an Air Force general hunting license (he can go to any meeting where research and development is the topic), Valley believes his most important function as Air Force Chief Scientist is to run a continual check on the way the Air Force is administering its R&D program, correcting attitudes, getting organizations streamlined. Although he has no direct responsibility for executive action, he has to weigh what he says, because even his casual suggestions sometimes result in immediate action.

Son of an electrical contractor, Valley was born and raised in New York City, becaume interested in science when, at the age of 10, he read *20,000 Leagues Under the Sea.*

"Occasionally waiting tables and picking up some scholarships," he graduated from M.I.T. in 1935, earned a Ph.D. from the University of Rochester in 1939 and spent the war years, 1941-45, as a group leader at the M.I.T. Radiation Laboratory.



As Dr. Valley sees it, military R&D has two main problems:

1. The inability of the Government to hire and keep a sufficient number of competent personnel, which is almost entirely due to "the Civil Service laws, which tend to weed out the exceptional and leave only the average person."

2. A complicated and antiquated bookkeeping system with so many different kinds of money budget limits that reasonable programs often cannot be adequately and promptly funded.

He maintains that duplicate research and development projects are not invariably a waste of money; on the contrary, the best idea often can't be picked out until after R&D has progressed a long way. Efforts to economize by trying to avoid duplication often waste huge sums by putting worthless weapons into production. The big money required is in production, not in research and development. Valley thinks Congress misunderstands this important fact and is thereby led to a preoccupation with research and development duplication.

Asked if this meant that everything should be developed twice, he answered, "Of course not; but there are no rules. A good research and development manager, like other good managers, knows when to take out insurance."

Valley is serving one year full time in the Pentagon because he thinks too many persons competent in their fields come into the Pentagon on a periodic advisory basis and end up on committees taking eight hours to make a decision they ought to reach in one. Most of their information is obtained in short briefings; they have to make decisions in the dark.

Quizzed on the U.S. research effort, Valley said the R&D program is bigger now than it ever was in World War II but "too much effort is being spent in getting a one percent greater improvement at a 20 percent increase in cost—there is not enough searching for or gambling on major technical breakthroughs."

When not involved in scientific matters, Valley spends his time playing golf (fair), dabbles in photography and a home workshop, "which I suppose come under the heading of 'occupational therapy.'"

However, you are most likely to find him, during his free hours, with his nose in a book. His taste runs all the way from poetry to the *Physical Review.* "From time to time I get interested in something and study it intensively until I've grasped the way the practitioners view their world. In this way, I've read up on the publishing business, psychiatry, the stock market, bookkeeping, writing short stories, etc."

Valley, who commutes on every weekend he can find free between Washington and his home in Lexington, Massachusetts, enjoys most the company of technical people in the atmosphere of a busy laboratory. Once asked what he did for recreation, he replied, "Think about what I'm going to do tomorrow."



score of the 10 factors indicates the

+31 to +40 This project will be

apparent at once as it was applied to

*The system described here has been used successfully at one of the Nation's largest research and development centers, the U.S. Army Signal Engineering Laboratories at Fort Monmouth. This is how they use . . .*

# A Better Yardstick For Project Evaluation

**by Brig. Gen. Earle F. Cook, USA**

RIGHT now we are entering one of the more accelerated periods in U.S. science, an acceleration vital to national defense and survival. As future research leads to invention and in turn to development, there is no longer room for projects which consume manpower and money with an ultimate negligible return. A yardstick is needed to reduce this likelihood, and it must be one that can be applied rapidly from inception to completion of a project.

At the U.S. Army's Signal Engineering Laboratories (USASEL), experience has shown that: we have undertaken some projects which led to major results at reasonable costs; some projects which led to major results but were quite extravagant; some which consumed a vast outlay of effort, time and money and (when completed) were just not worth it. In general, we were never reasonably certain in advance what we might expect.

We at USASEL feel that project-review methods established long ago fall short of the desired goal. We feel the established rules are not dynamic; they do not respond to rapid, varied changes of budget, manpower or facilities. There is no positive indication of projects that are really desirable or of areas which should be critically evaluated and probably eliminated.

Briefly, the long-established method is as follows: Once it has been determined that the Army has a need for a certain function to be performed, all existing equipments are reviewed to determine if any will satisfy the requirements of the specified tactical conditions. If none is considered satisfactory, a project is then set up to provide the needed equipment.

Seldom, if ever, do we consider that all the tactical objectives can be satisfied to the full extent desired. In most cases, it comes down to weighing the advantages of the contemplated equipment or system (over the existing facilities) against the probable difficulty and cost of the project.

Having started a project, we cannot just await developments; we must continue to evaluate. We must measure the progress being made toward satisfying current military objectives, and we must recognize that these may have changed considerably. Theoretically the procedure provides for all this. Actually, that it meets this end is most questionable.

What we really want to know is whether our research and development program is fully responsive to specified requirements, and whether the requirements continue to be realistic. We believe we now have an approach which provides these answers.

## Background

Not too long ago an interesting study by the Operations Research Office (ORO), Johns Hopkins University, became available to USASEL. ORO concluded that for maximum return from an R&D program with a development cycle of eight to 16 years, the development effort should be divided into four categories:

**Category one**—15% of the total effort should go toward improvement of equipments and systems considered to be 95% satisfactory.

**Category two**—25% of the effort should go on improvement of equipments and systems that are 75% satisfactory.

**Category three**—55% should go on improvement of equipments and systems that are 50% satisfactory.

**Category four**—5% should go on revolutionary equipments and systems for which there is no existing counterpart.

ORO derived the above percentage figures by weighing the probable return against the potential risk in each of the four categories. ORO then reviewed all the Army FY-56 projects and, largely by personal judgment, separated them into the four categories.

Considering only so much of the ORO study as pertains to the Signal Corps program, ORO found that we did not give sufficient emphasis to projects in which a major improvement could be expected, such as those in categories three and four. Where the ratio was not carefully controlled and the R&D effort proportioned, we found that there was a tendency for us to publicize the long-range activities while devoting most of our resources to completing short-range projects.

Stimulated by the ORO report and a desire to improve our project structure, a study was conducted by our planning staff to see if a single evaluating questionnaire could be developed.

Certain basic factors are either directly or indirectly specified in practically all Signal military characteristics. Ten such factors—covering such items as mobility, reliability, ease of operation, power requirements and producibility—were selected to rate the anticipated project in satisfying military objectives.

In determining the degree of improvement that may be expected from a particular project, the equipment under consideration is compared to the item it will replace. In the case of a new item, which has no existing counterpart, it is compared to the same class of equipment used in the tactical area for which the new item is intended. As an extreme example, the communications electronics equipment of a weapons system may be compared to the weapon it will support.

The first 10 questions on the chart were prepared to make the equipment comparison. Each factor is arbitrarily rated from −2 (characteristic of the new equipment is not as good as the equipment now in use) to +2 (much better than the current equipment). Factors which are equal to present equipment score −1. This seems fair, inasmuch as any development aims not just for improvements in one or two factors at a time but rather for improvements in all essential characteristics. Also, this prevents the equipment from being acceptable to the customer through his overenthusiasm in improving one factor to the detriment of others.

The algebraic sum of the individual

score of the 10 factors indicates the anticipated overall improvement of this equipment or system. In general, the score, which can vary from −20 to +20, has the following implications:

**−20 to −11** Existing equipment is probably better.

**−10 to −8** Existing equipment is 90% to 100% as satisfactory as this will be. (This is an ORO category one item.)

**−7 to +2** Existing equipment is 60% to 90% as satisfactory as this will be. (This is an ORO category two item.)

**+3 to +15** Existing equipment is 20% to 60% as satisfactory as this will be. (This is an ORO category three item.)

**+16 to +20** Existing equipment is less than 20% as satisfactory as this item will be. (This is an ORO category four item.)

We believe this gives us an indication of the anticipated progress toward improved equipments, but we still need to know what the relative difficulty, urgency and state of development in the particular field will be. Another set of questions (balance of chart) was composed which used the same scoring method from −2 to +2.

The score obtained from these questions can also vary from −20 to +20, with the following implications:

**−20 to −11** This probably requires supporting research.

**−1 to −10** Should be preceded by a thorough study.

**0 to +5** This will be very difficult to develop.

**+6 to +15** Average difficulty.

**+16 to +20** This will be productive and of less than average difficulty.

The score of each group of questions has a definite meaning but the combined score can also have a definite meaning. For instance, the equipment under development may be replacing an item that is 75% satisfactory; therefore, the first 10 questions will give it a low score. But, in order to be justified, it should have a high score from the second set of questions, indicating that it will be relatively easy to complete. Or it may be an item that has no acceptable counterpart in the Army today, giving it a high score on the first 10 questions, but be extremely difficult to develop, giving it a low score on the second 10 questions.

Considering all such factors, the total score has the following implications:

**−40 to −11** This should not be an equipment project.

**−10 to +5** Should be administratively justified and periodically reviewed.

**+6 to +20** Should be periodically reviewed.

**+21 to +30** Completely acceptable in all respects.

**+31 to +40** This project will be productive of urgently required equipment.

The point which must be emphasized is that the result obtained from the questionnaire provides several checks and balances. Where any one of these checks deviates from a desirable indication, the evaluation group is in a position to act. It is this feature which proved most attractive to us at USASEL. It made it worthwhile to conduct a thorough trial of the proposed project evaluation method.

Two divisions (with widely different responsibilities) conducted a survey of over 170 projects at USASEL to test the evaluation method. This was done under the guidance of the USASEL R&D Advisory Council. (This group is concerned with USASEL's overall problems and, in theory at least, is impartial to individual projects.

For each project an evaluation form was prepared independently by the appropriate division chief, branch chief and section chief. The results were tabulated and compared for consistency. The average of the three ratings for each project was computed.

Based on the results of the survey, the chief of one of the divisions has initiated action either to terminate or suspend 31 project items, and to redirect or clarify 10 other projects as to objectives and scope. Thus, out of 115 items reviewed in that division, 36% required some form of immediate corrective action.

One of the initial results of the division chief's action was to make available five engineers for assignment to newly established projects of high priority and value.

The worth of the new approach was apparent at once as it was applied to the second division. It indicated changes made necessary by newly evolved tactics to fit atomic combat. The changes cannot all be consummated except by major revision of the objectives of the projects. The analysis showed 26% of all projects to be in category one, 58% in category two, only 16% in category three and none in category four. It is obvious that in order to make any major improvement in the level of activities in this field, not only must the better projects be redirected, but new projects of categories three and four added.

Since the program in this division is one of our most critical support areas for Army's requirements, and since the current rate of progress is extremely slow, particularly in providing any basic major improvements, an extensive research program is indicated. This research program should include both technical means for advancing the state of development and operational techniques which might be employed to improve the tactical use of the equipments. While the desirability of such a program has been stressed in the past, this survey, for the first time, gave us a quantitative indication of the seriousness of the problem from a research and development standpoint.

As an example of the progress achieved in this particular field, let us examine a project for transistorizing a specific piece of equipment. This happens to be a surveillance device for use primarily within a Battle Group. To the surprise of many, this project received the highest score of any project in the overall group to which it belonged.

Why was this so? The device it would replace had to be operated by

## In Brief:

**1.—The proposed method of project evaluation provides a method of measuring both the basic objectives of the project and the relative difficulty of its accomplishment.**

**2.—The systematic use of such a method will aid materially in insuring that any development program is responsive to the current objectives of the organization.**

**3.—The project-evaluation method provides management with a valuable tool for rapidly assessing large programs and can probably replace some of the present methods which have produced questionable results.**

**4.—Periodic use of the questionnaire from initiation of a project to its completion provides a continuous record of the rate of progress and the relative difficulty at each phase of the development cycle.**

**5.—The project evaluation method is applicable equally to an R&D program, military or industrial, if the questionnaire used is so aimed and directed.**

an engine generator which made considerable noise and precluded use of the equipment in proximity to the enemy. If the transistorization project were successful, battery power would do the job silently, and detection by the enemy would be extremely difficult.

At the same time there would be such size- and weight-reduction that the equipment would be readily transportable and could be used very close to enemy positions. How the project scored in the opinion of the division chief is shown in the written portion of the chart. The score for questions 1 to 10 is +6, which makes the project an ORO category-three item. The score for questions 11 to 20 is +11, which indicates that the project is of average difficulty. And the combined score is +17, which indicates that the project requires periodic review.

Most other projects of this division were in categories one and two. There were six projects which received a score less than −10 for the first 10 questions, which raises serious doubts as to their tactical usability in comparison to existing equipments. Needless to say, a major effort is being made to readjust the projects within the division.

## System Advantages

Because we are concerned with a lengthy R&D cycle, a peculiar facet of project evaluation has come to light. At the inception of a new project there is consistency in the tactical requirement evaluation. There is also, at this time, a wide divergence of opinion as to the technical difficulties which will be encountered. After considerable time, everyone becomes familiar with the technical difficulties but there is widespread difference of opinion as to the tactical requirements and worth of the project. Perhaps the tactics have changed, or some new weapon has been introduced, or a potential enemy has changed his *modus operandi*. It presents an intriguing situation. This, of course, is justification enough for periodic reviews to see that the project still has desirable stature.

We found also that the use of the project-evaluation questionnaire on existing projects provided valuable information as to how effectively we were administering a project. In one case, a section chief scored a project −8, the branch chief scored it +7, and the division chief scored it −2. Something was wrong. It was discovered that this difference was due to the section and division chiefs not having been briefed by the branch chief on a possible future application for the equipment (which he had worked out on his own).

The potential application using improved characteristics would constitute a major improvement, but the lack of coordination necessary for its successful accomplishment was only revealed by project evaluation. Once the division and section chiefs were aware of the possible application, their evaluation became compatible with that of the branch chief.

## Limits

It must be understood that we are not suggesting the blind use of the questionnaire to the exclusion of common sense and good judgment in project evaluation. It is, rather, intended that the proposed method highlight specific projects which require further examination. Just as a radical departure from any predicted trend curve warrants attention, scrutiny and careful analysis, so it is with the scheme for project evaluation.

Based on the results that we have obtained, USASEL is using this method for all project evaluation. We are now applying it to all other project areas and systems projects on an annual basis. We realize that major changes cannot be made immediately because of many factors and commitments. However, within one year it should be possible to effect a major improvement in our programs in all areas of R&D.

As indicated earlier, the questionnaire is applicable equally to proposed as well as to existing projects. A much sounder project structure can be maintained by reviewing all proposed projects at the time they are being established.

A suggested method would be for each echelon in the chain of command through which a new project must pass for approval, to complete an evaluation as seen at that level. This would provide both an indication of the value placed on the project at any particular level and would indicate also what improvement in basic characteristics is anticipated. From this should come a clarification of development objectives at all echelons plus positive program planning.

Such a record would aid also in maintaining continuity during development and the service-test cycle if there has been a change in personnel at the requesting, approval or development level. This should be of particular value at this time of new tactics exploration, which is resulting in certain equipment characteristics being stressed to a greater extent than in the past.

Quite often we in the military suffer from too much remote control. Having each sponsor and reviewing authority evaluate in a similar manner, yet tailoring the evaluation to fit the echelon involved, may provide the intimacy so valuable to the desired end result.

**Army's new portable giant camera, developed by the U.S. Army Signal Corps in conjunction with The Kalart Co., can photograph military objectives up to 30 miles away. Hundred-inch lens penetrates fog and overcast taking detailed photos in inclement weather.**

EL-SC Form 6142
1 June 57

**EVALUATION FOR EQUIPMENT AND SYSTEMS TASKS**

Equipment Designation RADAR SET AN/PPS-4 TRANSISTORIZED
Comparison Equipment:
Similar Item or General Class if not an exact replacement RADAR SET AN/PPS-4 TUBE MODEL
Task No. 3-20-06-405 Rater C.K. SHULTES Date 22 MARCH 57

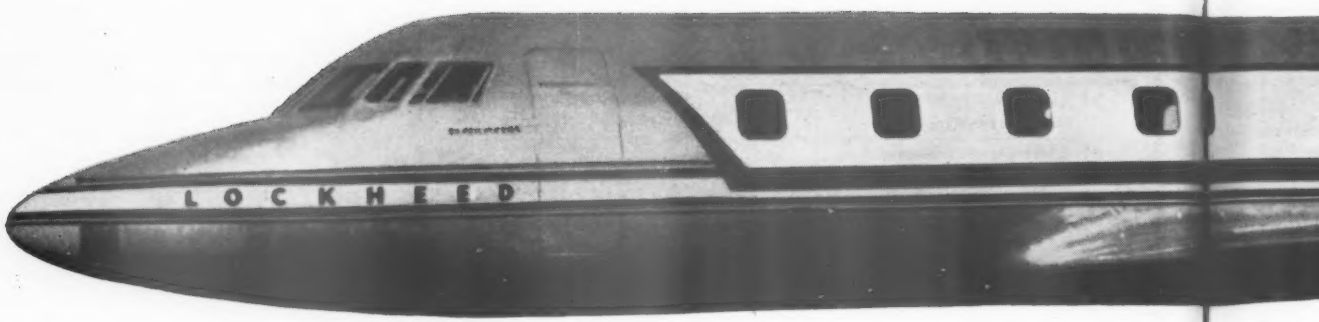
**Evaluation Criteria**

| Using Comparison Equipment as base, Developed Equipment compares in respect to: | A Unfavorably | B Equal To | C Appreciably Better | D Much Better |
|---|---|---|---|---|
| 1. Mobility | | | X | |
| 2. Reliability | | | X | |
| 3. Flexibility | | X | | |
| 4. Ease of operation | | | X | |
| 5. Vulnerability to enemy operations | | | | X |
| 6. Operational planning requirements | | | X | |
| 7. Power requirements | | | | X |
| 8. Reduction of unwanted radiation | | X | | |
| 9. Producibility | | X | | |
| 10. Logistical support | | | X | |
| Other - specify requirements | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 11. The item that this equipment will replace is | | 95% Satisfactory | X | 75% satisfactory | | 50% or less satisfactory | | No. existing item |
| 12. The method of tactical employment is | | Not known | | Vaguely indicated | X | Generally indicated | | Clearly indicated |
| 13. The last similar item has been standardized | | Over 10 yrs. | | Less than 5 yrs. | | 5 to 10 yrs. | X | No similar item |
| 14. Work in this field is supported | | Strongly by commercial organizations | | Moderately by commercial organizations | | Jointly by military organization | X | Primarily by a single service |
| 15. This project will provide service test models within | | Over 6 yrs. | | 3 to 6 yrs. | X | 1 to 2 yrs. | | Less than 1 yr. |
| 16. At the time of issue, will be compatible with other items for | | Will not be compatible | | 2 yrs. | | 3 to 6 yrs. | X | Over 6 yrs. |
| 17. Other approaches to satisfy this requirement | | Have not been considered | X | Are now being considered | | Not considered within last 2 yrs. | | Have recently been unfavorably considered |
| 18. Major emphasis is required in the field of | | Applied research | | Component development | | System engineering | X | Equipment engineering |
| 19. This work is related to | | Study of phenomena | | Material | | Technique | X | Item development |
| 20. It is believed that the results of this work | | Are not needed | | Of general interest | X | Of major interest | | Urgently needed |

Enter X adjacent to block containing best relation

SIGFM/EL Ar-19649

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**2.** *Electronics countermeasures trainer:* The JETSTAR can carry all the complex electronics gear required for all-weather missions so necessary for training ground and airborne radar

and con
against e

**3.** *Airw*
*systems:* T
weather"
compar
bombers
adequacy

**4.** *High-*
JETSTAR c
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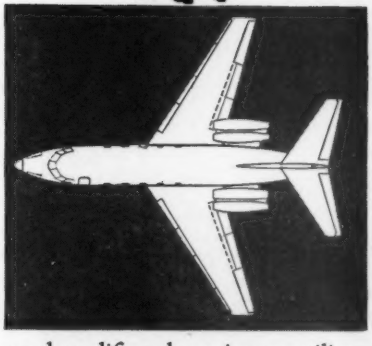

and communications personnel against enemy jamming techniques.

**3.** *Airways and Air Communications systems:* The JETSTAR flies "over the weather" at altitudes and speeds comparable to tomorrow's jet bombers and jet transports to check adequacy of navigational aids.

**4.** *High-priority cargo carrier:* The JETSTAR can carry up to 4,000 pounds of urgently needed supplies and equipment to distant bases at Jet Age speeds. Completely pressurized and air-conditioned, the JETSTAR is ideal for aero-medical usage.

**5.** *High-priority personnel transport:* The JETSTAR can carry 10 decision-making officers (and crew of two) to their destination, at cruise speeds of better than 500 knots. High-density configuration: 22 passengers, plus crew.

**The new** Lockheed JETSTAR is available with 2 or 4 engines (basic airplane contains provisions for quick engine convertibility). The JETSTAR has the rugged stamina and easy maintainability designed into all Lockheed planes. These qualities insure long life and maximum utilization—dollar-stretching qualities that are more important today in military aircraft than ever before.

**LOCKHEED *means leadership***

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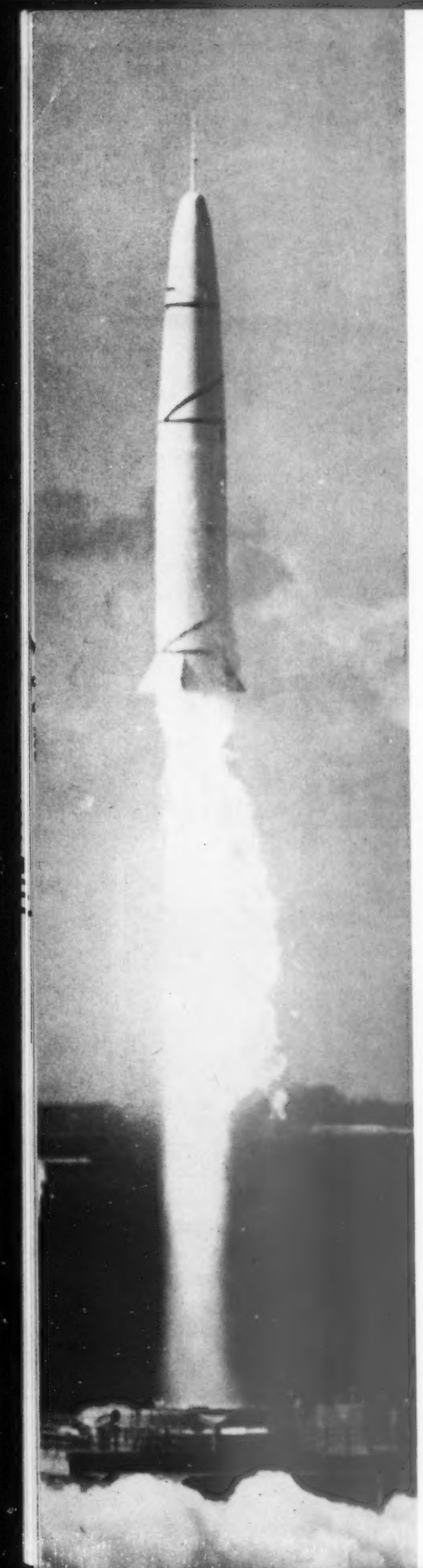


*This nation's air defense depends upon a responsible, flexible and highly mobile support system. It is provided through the techniques, procedures and methods embodied in the weapons management concept. Here is . . .*

# How Air Weapons Management Works

**by Maj. Gen. William O. Senter**
*Director of Procurement and Production, Headquarters, Air Materiel Command*

WHAT does the Air Force mean when it talks of weapon system management? Why is this management concept important? A quick look at aeronautical progress during the past few decades may help to answer these questions.

In the 1920s and 1930s, procurement and employment of an aerial weapon were relatively simple. The aircraft industry built the basic airframe to military specifications; the powerplant, instruments, armament and special equipment which made the basic vehicle into a combat airplane were furnished from Government stocks.

Since all military aircraft employed similar or identical equipment, training, maintenance and supply were relatively uncomplicated. For example, as recently as World War II an aircraft armorer, once trained, was qualified to assume responsibility for the guns on nearly any bomber, interceptor or ground support aircraft. The jobs of buying, equipping, maintaining and supplying the Government's military aircraft were marvels of simplicity in terms of the present frame of reference.

Obviously, this simplicity has long since disappeared. Now the armament technician must also be versed in the principles of radar and hydraulics in order to serve today's complex aircraft fire-control systems. The advent of costly, high-performance, jet-powered aircraft, each designed to carry out a specific combat mission, gave rise to management problems which had to be solved through the use of new techniques. The air vehicle is but one of the important components which, taken together, constitute a weapon system. The entire system is closely integrated. The interdependence and importance of each facet of a weapon system make centralized management responsibility essential.

In the early stages, a weapon is managed by Air Force Headquarters with the assistance and advice of industry, the using command, the Air Research and Development Command and the Air Materiel Command. Executive management goes to the Air Research and Development Command during the initial development stage. The Air Materiel Command receives the prime management task after a decision is made to produce the new weapon for operational use; the Air Research and Development Command, however, takes on a supporting role which it retains to some degree throughout the useful life of the weapon.

As the Air Force began to apply weapon system management to its operations, it also sought to delegate a portion of the job to the prime aircraft contractors. Here was an opportunity to direct the managerial skill and ingenuity of private industry to the task of producing a complete weapon system. In the case of the Nation's first supersonic bomber, Convair's B-58 Hustler, the prime contractor was given complete responsibility for producing the desired weapon. Only the engines were furnished by the Government. The "centralized technical direction and coordination needed for the successful combination of all new equipment and subsystems designed for the B-58" could be provided only through contractor-applied weapon system management.

It took several years to develop a weapon system management concept. As in most enterprises, the officials employing the new concept had to be convinced that it must and could work. Once they were convinced, they had to instill this confidence in managers throughout the Air Force logis-

tics structure. After this was accomplished, responsible offices could pursue their responsibilities with a positive and aggressive approach.

In present-day Air Force operations, teamwork is essential. Communications channels crisscross and fan out in all directions until many times it appears they would ensnarl an Einstein. User, supplier, engineering agency, manager, contractors—all enter the picture. To illustate the scope of the communications network, the Wichita (Kansas) Division of the Boeing Airplane Company received material, parts, supplies and services from 3835 different sources throughout the 48 states in support of its B-47 and B-52 programs. Every modern air weapon contains a myriad of systems and subsystems produced by almost all portions of American industry.

The management of the B-52 Stratofortress program offers a good example. The Oklahoma City Air Materiel Area, as the lead air materiel area, is responsible that the Strategic Air Command's long-range jet bomber fleet is operationally ready and equipped with all gear and components to provide optimum combat capability. Many of the Stratofortress' systems and components are stocked, maintained and supplied by other Air Materiel Command installations. This points up the interlocking action which must take place. The aircraft manager has no whip; he must work as part of a team with other Air Force agencies and with contractors to obtain the support required for his aircraft.

Weapon system management has developed a single-point-of-support responsibility. Communications for the operating commands are simplified by designating a single Air Force support agency as the point of contact for logistic problems pertaining to a specific weapon. Beyond this, it affords aircraft manufacturers a central point to which they bring technical and contractual problems. Areas of responsibility are more closely defined. The Strategic Air Command, for example, does not have to make a minimum of 15 telephone calls to get an answer to a support problem.

Staff visits to organizations equipped with the manager's prime aircraft enable interested parties to interchange information, understand better one another's problems and respond more quickly to operational needs. Meetings with customer commands' top staffs serve to establish better communications liaison. It is vitally important that the customer keep the logistics manager informed of his plans; that higher headquarters include lower-echelon representatives in their deliberations on matters being managed at the lower levels; that contractors pass along information to the agency responsible for logistics planning and support; and that once a decision is made, it is disseminated to all participants. An indispensable ingredient of effective communications is mutual trust and confidence.

The responsibility for air weapons logistics management is given without the necessary authority to control positively the actions of all who participate in the support phase. The participants in air weapons management throughout the life cycle *cannot* be placed under the direct authority of the weapon system manager: these include numerous contractors, testing agencies, higher echelons of material-allocating agencies, budget authorities and last but not least, the operating commands—or customers.

Furthermore, weapons management requires the lead air materiel area to be able continually to ascertain the combat readiness of a specific weapon system; indeed, the area should serve as an "office of record" for its prime weapons. A comparison of actual operating data with the weapon's predetermined programmed objectives constitutes the surveillance phase of weapon system management. Therefore, the first and number-one tool of the logistics weapon system manager is *documentation*. The record must be kept straight, daily, and decisions must be recorded, readily available to all participants in the management cycle.

The tools of documentation—daily status reports—provide the factual data from which all affected Air Force agencies can manage within a given area, commensurate with designated responsibilities.

Documentation includes complete configuration information on the weapon—the status of its modernization and the modification kits and the weapons to which they are applicable. This type of control, configuration as well as inventory, must be available on electronic data-processing equipment. The Air Materiel Command has passed the two-year mark in its five-year program designed to apply electronic data-processing procedures to weapon system management. The quick availability of essential data makes possible "impact studies" made instantaneously rather than months after the decisions are reached. There should be little argument when the impact of a decision—operational or budget—is immediately available to the "decidee."

With his electronic data-processing equipment, records and documentation, the weapon system manager acts like the wise moderator of a study group, letting the contest go on but stepping in to point out the cost in

### About the Author

As head of the "buying" directorate of the "biggest business in the world," Major General William O. Senter on August 15, 1957, assumed

one of the most responsible positions of his 22-year military career.

On that date he became Director of Procurement and Production at the Air Materiel Command's headquarters, located at Wright-Patterson Air Force Base, Ohio. He previously had been Commander of AMC's Oklahoma City Air Materiel Area.

As the logistic arm of the Air Force, charged with buying, storing, transporting and maintaining the aircraft, missiles and support equipment necessary to maintain America in a state of air readiness, AMC, under overall command of General E. W. Rawlings, spends upwards of $16 billion a year in the Nation's defense. Its procurement covers over 1,375,000 items annually, ranging from complete weapon systems to the smallest stop-nut. It is the world's largest buying organization and, with tangible assets in excess of $45 billion, its largest business.

The "buy" falls under General Senter's jurisidiction. With staff responsibilities including procurement, production and mobilization planning, his organization is comprised of nearly 12,000 civilians and 750 officers who have, directly or indirectly, surveillance over thousands of manufacturing operations.

dollars, the lead time available, and the contradiction of decisions—before it is too late.

Successful weapon system management requires certain modifications to the traditional concepts of chain of command. Any one weapon system will be comprised of many different major components; under the Air Force system of materiel support, each component "belongs" to a different air materiel area or Air Force depot. As noted earlier, in the case of the heavy jet bomber, the Boeing B-52, the Oklahoma City Air Materiel Area is the weapon system manager or lead air materiel area. The big aircraft's basic structure is "prime" at the Oklahoma City Air Materiel Area, but its J57 engines are a San Antonio Air Materiel Area responsibility. The radio communications gear is a prime task of the Dayton Air Force Depot, while the jet's bombing and navigational equipment belongs to the Warner Robins Air Materiel Area. Shelby Air Force Depot manages the tires and the Ogden Air Materiel Area the landing gear. The weapon manager cannot "command" in the traditional sense but must rely on the participants' good judgment and desire to build an effective weapon.

**Five of these new automatic tracking telemetry antennas, each higher than a seven-story building, are going up along the 5,000-mile test range of the Air Force Missile Test Center, Cape Canaveral, Fla., to track ballistic missiles.**

Remember also that the lead air materiel area for a particular weapon system will be involved as a participant in many other weapons prime at various Air Force organizations. Oklahoma City's J47 turbojet engine powers several weapon systems managed by other air materiel areas—Sacramento Air Materiel Area's F-86D, San Antonio Air Materiel Area's B-36 and San Bernardino Air Materiel Area's B-45—and the command's aircraft and engine accessories have application to nearly every Air Force airplane type. Each air materiel area is, in effect, working for several bosses.

The air material area position of serving many masters is especially evident at its Air Force plant representative offices. The plant residencies are established to act as the official on-the-spot agent for the Air Force in dealings with the contractor. This is a complex, difficult and important role. An Air Force plant representative is directly responsible to his own air materiel area; usually, but not always, this air materiel area is the weapon system manager for the major undertakings within the contractor's plant. The plant representative administers the Air Force contracts held by the manufacturer and performs general surveillance of the plant's production and quality control. These Air Force plant representative functions are, in turn, closely watched by the parent air materiel area's directorate of procurement and production.

More often than not, air materiel area contract, production or quality-control specialists advise their opposite numbers at the plant representative offices on technical matters without the formal, signed approval of the air materiel commander. Consider an example. Perhaps the Air Force representative is faced with a problem of contract delivery-schedule delinquency. Production specialists at the air materiel area headquarters suggest ways and means for cleaning up the delinquency or actually visit the plant representative's office. The air materiel area commander's authority must always accompany policy changes or directives, however. Similar technical channels also link the efforts of Headquarters, Air Materiel Command directorates with those of the subordinate air materiel areas.

In addition to quantity weapon system production, the prime contractor ordinarily holds research and development contracts. Boeing's IM-99 Bomarc missile is one example of this type of undertaking. At this point of development the plant representative's administration of the developmental contract is almost entirely under the supervision of the Air Research and Development Command—the weapon system's executive agent. Here again it is plain that the duties of an Air Force plant representative are not confined within the narrow limits of his home command. The plant representative at the Boeing-Seattle plant works for both the Air Materiel Command and the Air Research and Development Command. He is, as the name indicates, an agent of the Air Force.

An Air Force plant representative's relationship with the various organizational entities within his air materiel area's headquarters is also a problem for weapon system management. The functional efforts of maintenance, supply and procurement and production must be brought to bear upon the single weapon system in question. Field inquiries and problems usually fall within one of the air materiel area headquarter's functional areas; sometimes they do not. Which organization is to assume responsibility for this latter category? Air Force plant representative and air procurement district matters which cannot be clearly identified with the functional directorates are referred to Programming's weapon monitors. The monitors—highly qualified individuals with broad knowledge of their particular weapon system—operate within an air materiel area headquarters in much the same fashion as the lead air materiel area operates within the Air Materiel Command. "Lateral coordination" is employed to insure that headquarters directorates are aware of field problems and that action is initiated leading toward problem solution.

These so-called examples of divided responsibility place no real obstacles in the way of effective weapons management. Lateral coordination and working for more than one boss are both natural and workable. Indeed, the support of aerial weapon systems would not be possible using only narrow, traditional command channels. Once all participants recognize the signal-caller, coordinate carefully, work for each other and aggressively pursue their own responsibilities, the Air Force's combat organizations will be ready to provide adequate defense at the time that it is most needed.

The management of the Strategic Air Command's two jet-bomber aircraft can be used as an illustration of the assumption of authority. In the case of the eight-jet B-52, the Weapon System Project Office is the executive manager. The Oklahoma City Air Materiel Area, as the lead air materiel area, acts as the focal point for maintenance and supply support matters and provides assistance to Strategic Air Command wings equipped with the Boeing long-range aircraft. It monitors Air Materiel Command-wide actions in support of the in-service fleets. In addition, it functions as a problem-solver for Strategic Air Command's Strato-

fortress difficulties, working in concert with the contractor's engineering staff and the Wright Air Development Center in the correction of design deficiencies and component malfunctioning. In the overall management of this aircraft, however, Oklahoma City and its resources are at the disposal of the Weapon System Project Office. The Oklahoma City command's role, although not that of the executive agent, is a most important one.

B-47 management is another matter. The Oklahoma City Air Materiel Area acts as the Air Force's executive agent for the logistics management of this medium bomber; the Air Materiel Command passed complete responsibility down to the local headquarters on 30 November 1956. As a result, the Dayton headquarters and the testing facilities and laboratories at the Wright Air Development Center place themselves at the disposal of the local headquarters in the solution of any in-service engineering problems. Local officials manage total in-service support and coordinate the actions of other Air Materiel Command depots in furnishing required materiel.

Weapon phasing groups, for their part, act as an adjunct first to the Weapon System Project Office and later to the lead air materiel area. As such, they provide a vehicle for getting all concerned Air Materiel Command agencies, the using organizations and industry together to review programming and status of various actions or projects; clearly define problems and assign them to the proper organization for solution; and take necessary action to insure the delivery of complete weapon systems with all supporting spares, equipment and technician data. These get-togethers are a means of furnishing all participants the same basic information and of speeding up communications; consequently, they act as an expedient in the resolution of support problems. The Weapon Phasing Group, essentially, is a tool used by the executive manager in meeting his management responsibilities.

It has been noted that even though full authority cannot be decentralized to the multitude of weapon system managers, the Air Force, through lateral coordination and teamwork, is accomplishing its desired goals. The manager can assume enough authority to meet his responsibilities.

What is it that makes the weapons management system a workable one? Traditional techniques of good management, proper documentation with its immediate responsiveness through the use of electronic data-processing equipment and lateral coordination so complex that the management chairmanship rotates "on the hour"—these are its tools in trade. The ability to work for more than one boss and to assume needed authority are other essential attributes of a successful weapon manager.

New XMC-2 full pressure suit undergoes realistic tests in multipurpose high-altitude simulator, part of preparing pilots for space at the same time AF prepares hardware.

Weapon system management affords the Air Force greater flexibility, mobility and responsiveness in meeting changing conditions and new situations. The tools enumerated are used to determine promptly the best management direction. Action can be initiated at once and the participants briefed after the fact.

The recent Suez flareup gave the Air Force ample proof of the workability of weapon system management. The routine, day-to-day weapon management associations had resulted in close coordination between the United States Air Force operational and supporting components. Requests for support in the face of the tense international situation were anticipated and filled almost before the United States Air Force communication system had a chance to react. It is highly improbable that this type of teamwork and lower-echelon initiative could be made or allowed to function within a totalitarian political system.

Tactical Air Command's composite force poses for an aerial portrait—KB-50 leads pack, refueling an F-100 (right wing), RF-101 reconnaissance jet (left wing) and B-66 tactical bomber, with C-130 Hercules transports bringing up the rear.

*The Army is trying, with its Command Management School, to prepare officers for the tremendously important job of managing an installation. This is an outline of what the school does for . . .*


# Army Command Management Education

**by Col. Frank Kowalski, Jr.**

KARL L. Bendetsen, then Assistant Secretary of the Army for General Management, said in 1952 that the commander was the true manager of the Army. Deploring the lack of management education for commanders in the Army school system, he pointed out that officers receive "unexcelled training" in the command of tactical-type units, but virtually no education in the management of nontactical installations.

In actual practice the officer finds himself in command of tactical units half (or less) of the time; most of his time is spent running nontactical operations.

Bendetsen's claim burgeoned, in 1954, into the Army Command Management School at Fort Belvoir, Va. The school was told to develop a course which, as completely as possible, would do the following:

**a. Encourage** the investigation and acceptance of new approaches to management problems.

**b. Provide** an assessment of the application of modern business methods to Army command management.

**c. Increase** overall command management ability by providing participants with the opportunity to correlate (in their own thinking) the traditional, sound concepts of command leadership, new management methods, experience, etc., through discussion of current management problems of the Army.

**d. Familiarize** participants with Army management methods and their application to financial, programming and manpower problems in the Army.

**e. Develop** a better understanding of the importance and complexities of human relations in command management.

**f. Provide** a forum for exchanging information and ideas between field installations and top policy levels.

To cover these objectives, the school outlined six broad discussion areas:

**a. General management** (includes an introduction to management problems, the application of management to the Army, the role of the commander, organization, military-civilian relationships, human relations, decentralization, use of consultants, building the management team, etc.).

**b. Program management** (covers the Army Program System, including definitions and objectives, structure, development, execution, review and analysis and relationships with other systems).

**c. Financial management** (covers the financial policies and practices of the Army, including the elements of integrated accounting, financial property accounting, stock funds, industrial funds, consumer funds, internal audit and cost of performance budgeting).

**d. Manpower management** (includes an introduction into the problems of providing adequate manpower for military needs, operation of the Army's manpower control system and command management responsibility for utilization of manpower).

**e. Army Command Management System** (includes orientation and discussion of the integrated system of programming, budgeting, accounting, performance analysis and manpower control).

**f. Miscellaneous subjects** (cover problems in public relations, and include the application of leadership principles in command management and the use of scientific management tools in solving Army problems).

Instruction is accomplished by four distinct methods—lectures, discussion groups, visiting speakers and class seminars. Most instruction is accomplished by thorough discussion of a series of cases taken from actual situations at Army installations. Each highlights one or more practical problems in the field of command management. Faculty members serve as discussion leaders and stimulators—they never express the school's "official" thinking. Utilization and value of all management tools—especially the new ones in such fields as planning and programming, manpower management and financial management—are stressed.

Probably no other method of instruction is so demanding on its participants. No ready-made general themes are presented. There are no answers to memorize. Each case presents the student with an opportunity to think for himself, to project himself into the situation and to think responsibly with regard to the particular situation and circumstances.

In the last several months, the school also has experimented with the "incident method" of case presentation that has been developed at Massachusetts Institute of Technology. Under this method, the students are given only a very brief synopsis of a happening—perhaps six to ten lines. They then attempt to construct the case by asking the discussion leader factual questions.

Using speakers from industry, government and education fields, the school brings to the classes the latest thinking, innovations and techniques in management.

The class seminar also is employed, although it is the least used of the various instruction techniques. In the seminar, a free discussion of any subject related to the topic is developed. Special techniques and abstractions are stressed in seminar sessions.

The Army is making available to its high-level senior officers and key civilians training comparable to that provided their counterparts in industry. The skill and knowledge which they already have obtained through tactical-type experience and education are being complemented by a training program beamed at management practices of the nontactical job.

The advent of new management tools and systems makes available to the commander more and better information on which to base the decisions which he alone must make. There is an extremely valuable opportunity for the exchange of ideas and viewpoints on each situation. Department of the Army representatives, selected for their knowledge of particular subjects, give first hand the Department of the Army viewpoint and hear directly from field personnel.

## Army Sets Up Missile Command

The Army has set up an **Ordnance Missile Command** at **Huntsville, Ala.,** as of March 31, according to Army Secretary Wilber M. Brucker. Brucker has extended to the new Command administrative shortcuts and right of direct access to him and the Chief of Staff.

**Major General John B. Medaris,** who heads the command, will have under his direct control the Army Ballistic Missile Agency (including ABMA Project Office at Cape Canaveral, Fla.), the Jet Propulsion Lab at Pasadena, and the Redstone Arsenal at Huntsville (which will be renamed the Army Rocket and Guided Missile Agency) and the integrated White Sands Proving Grounds.

The integration of these primary research, development, test and logistical support installations under single direction, together with administrative streamlining, are expected to provide more effective means of carrying out present and future priority Army programs.

## Army Plans Astrophysics Schooling

The Army is presently negotiating with **civilian schools** to arrange **graduate training in astrophyhics** for a specially selected group of officers.

The two-year courses, to enable officers to study for Masters degrees, will include introductory graduate classes in optics and spectroscopy, thermodynamics, kinetic theory, modern physics, astronomy, nuclear physics and mathematics, as well as astrophysics. Exceptional individuals may have their training extended one year to obtain doctorates.

If negotiations are successful, the first officers will begin study in June, probably at the **University of Virginia.**

## MAAG Personnel Course Planned

**The Defense Department** has approved a plan to establish an accelerated orientation and training course for key military personnel assigned to oversea **Military Assistance Advisory Groups.**

The Assistant Secretary of Defense (International Security Affairs) is responsible for overall direction of the MAAG course. It will be conducted by a civilian contractor under Army supervision. Approximately 100 Army, Navy and Air Force students are expected to attend each of the 10 to 12 classes a year of the four-week course, to be conducted in the Washington area.

## Things to Come— No More KP?

**The Prophet Co.,** a coast-to-coast food management and consultant firm, begins, this month, providing the entire food-service needs in the several enlisted men's dining halls at **Bolling Field, Washington, D.C.,** and **Ft. Myer, Arlington, Va.**

The contract feeding plan is designed to release lower-grade enlisted men for jobs in their own sections.

## Marines Reorganize

**A nuclear-age reorganization** of the entire combat structure of the **Marine Corps,** now entering its final phase, will be completed by September 30, 1958, according to General Randolph McC. Pate, Marine Corps commandant.

The streamlining program embraces all of the Corps' Fleet Marine Force units—three divisions, three aircraft wings and combat support elements. Basically, the reorganization involves creation of lighter, faster, more mobile combat units organized and equipped to conduct modern amphibious operations, including vertical assault by helicopter, under conditions of either nuclear or non-nuclear war.

## Atomic Simulator Developed

**Admiral Corp.** has developed a new **radiac simulator,** an instrument which makes harmless radio waves behave like radiation in a nuclear fallout area, in order to safely train military personnel in detecting atomic radiation. This device was developed under sponsorship of the **Department of the Army Participation Group** of the U.S. Naval Training Device Center, Port Washington, N.Y.

Trainees learning to explore radiation fields, for instance, carry the instrument, which can be energized by harmless radio signals from a nearby transmitter. Thus they learn their hazardous trade without exposure to deadly radiation rays. The instrument they will carry in actual field work looks and behaves in a fallout area exactly as the radiac simulator does.

## First VTU Missile Unit

**In a continuing** effort to keep abreast of the latest developments in the guided missile field, the **Marine Corps Reserve** has activated its first **Volunteer Training Unit, Specialist, Guided Missile.** The unit has been set up in the Fifth Marine Corps Reserve and Recruitment Dist., Arlington, Va.

## Missile Training

Eight SAC airmen and one officer, selected because of their technical experience in dealing with complex weapon systems, have started training at the General Electric Company's Missile and Ordnance Systems Dept. plant in Philadelphia on the Thor IRBM nose cone.

Part of the Free World's first missile crew, the nine men will form a cadre of the 672nd Strategic Missile Squadron, scheduled for deployment in England this year. In the photo, Col. Harry Zink, commander of the 672nd, briefs the men in front of mockup of WS 315A (Thor) launch-site nose-cone equipment. GE is providing technical instruction, will continue to do so when Thor is operational. RAF troops will begin the training cycle in May.

## Computer to Aid Missile Sub Project

**Navy officials** plan to install an **IBM 705 computer**, first large-scale electronic computer to be installed in any U.S. naval shipyard, at **Mare Island Naval Shipyard,** Vallejo, Calif., to coordinate and speed construction of the new **Polaris missile-launching submarine** being built there.

The 705 has been assigned to assist shipyard officials in nearly every phase of the yard's complex $80-million-a-year operation from design work to production forecasting and scheduling, management reports, inventory control, billing, cost accounting and payroll for the yard's 9500 employees. The yard's commanding officer, **Rear Admiral M. J. Lawrence,** says, "We anticipate savings from conversion to the system of around $250,000 a year."

## Major Change Seen In Packaging

**A major development** by the **Defense Department** for the **mass movement of supplies** around the world is

**Double-end doors make loading of Cargo Containers an easy job.**

pointing towards a revolution in the handling, storage and shipment of freight.

In its effort to sustain military forces around the world, the DOD has come up with a standardized packaging development that cuts costs and greatly eases the handling of many materials. Called "Cargo Containers" (or CONEX (container express)), they are metal, reusable shipping containers that have enabled the Army to move an entire combat division in a single operation.

Manufactured by Jeta Metal Fabricators, Inc., these all-steel containers allow the Armed Forces to eliminate costly packaging problems, and related and unrelated materials can be packed together rather than in separate crates.

## Funk Asks Small Business Aid

**Major General Ben I. Funk,** Ballistic Missiles Manager for the Air Materiel Command, told **San Fernando Valley** small business concerns they may expect **additional subcontracts** in support of the Air Force's top-priority ballistic missiles program, "if they are able to develop and produce the hardware which is urgently needed for the successful completion of the program."

Announcing the establishment of a full-time small-business office within the Ballistic Missiles Office, Funk said, "We, in the Air Force, feel very strongly that, if we are to maintain our superiority in the air power race, we must continue to rely on the combined and continued contributions of American industry, large and small. It then follows logically that we not only want your participation in the ballistic missiles program, but that we need it badly."

The General revealed that almost 21%, or more than $267 million, of all subcontracts let by prime contractors in the ballistic missiles program have gone to small business concerns employing 500 or less people. He added that almost 50% of the money spent on the Atlas ICBM has gone to small-business subcontractors.

## Missile Spending To Top $15 Billion

**Defense Secretary Neil McElroy** said recently that procurement for aircraft, missiles and other items of hardware will total more than **$15 billion for FY '58.**

Procurement for the second half of the fiscal year, *i.e.*, January through June '58, will be more than $10 billion. Current plans call for placement of orders for major hardware items at a monthly rate between $1.7 and $1.8 billion.

## Sylvania Jumps Into EDPE

**Sylvania Electronic Systems Div.** of Sylvania Electric Products, Inc., has established a **new laboratory** which will specialize in research and development in the field of **electronic data processing.**

In announcing the new facility, Sylvania said it "represents a continuation and expansion of the division's development work on special-purpose digital computer equipment and related data-processing devices for military applications. It is the result of 10 years steady growth of research and development in this field."

The division already has three major projects—work on a Mobile Digital Computer for Army field use; a Universal Digital Operational Flight Trainer for the Navy; and a Ballistic Missile Early Warning System for the Air Force.

## GAO Attacks Redstone Costs

**The General Accounting Office** has reported to Congress that loose contract procedures resulted in **"unreasonably high costs"** for production of the **Redstone** ballistic missile. Report held the prime contractor, **Chrysler Corp.,** and the **Army** to account.

GAO said an audit of the company's books shows it paid an average of 60% more than necessary for certain of the missile component parts. In one instance, the watchdog agency said, Chrysler subcontracted for several hundred parts at $36.42, but subsequently discovered the same components were available for about $2.52. The report, under Comptroller General Joseph Campbell's name, was sent to the House Government Operations Committee.

The General Accounting Office has recently focused its efforts on subcontracting and other procurement techniques. It has handed at least four detailed reports to Congress so far this year, and presumably will continue to look into the huge defense contracting business. In testimony before the Hebert Investigations Subcommittee last year, the agency disclosed its intention to bear down.

## AMC Cuts Stock Requirements

**Improved effectiveness** of the Air Force and about a **half-billion-dollar reduction** in requirements for stocks on hand are expected to result from application of a new 60-day-war concept supply policy.

Through lowering of stock inventories, tremendous reduction in future costs also will be achieved, according to the **Air Materiel Command.** The new stock levels, aligned to the shortened concept of the decisive phase of war, assure support of all units for a full 60 days. Minimum additional stocks are provided to maintain this level of support during current peace-

time operating conditions. All reserve tables, constituting frozen assets in excess of $200 million, are being eliminated. Abandoned is the old method of extensively stockpiling many months' supplies at oversea bases.

## DOD Maps Recession Fight

**Both on its own hook** and at the request of **Congress, the Department of Defense** is planning several moves to fight the **recession.**

Among them: A speedup in obligation of unappropriated funds, which DOD has told Congress "runs into billions." Also, the Defense Department is pushing the services to "seek out" ways to give more business to smaller firms and labor-surplus areas as an anti recession measure. A DOD plan is to insert a clause in prime contracts requesting firms to let subcontracts to areas in this order of preference: (1) small concerns in labor surplus areas; (2) other businesses in these areas; (3) small firms in other areas.

## TV Speeds Weather Briefing

**Pushbutton weather briefings** have arrived at certain Air Force bases, primarily on the Eastern seaboard.

Manufactured and installed by **Dage Television, Div., Thompson Products, Inc.,** the new weather-briefing system, called **"Weather Vision,"** has been an instant success. Using one of the world's largest closed TV circuits, Weather Vision provides continuous round-the-clock, simultaneous weather briefings and display of general weather information to pilots and personnel at many widely scattered areas at the base. The new system, installed at Andrews AFB, Md., is credited with "great" savings in time, money and personnel, and increase in operational efficiency.

**Lockheed's new, small jet utility transport, The JetStar, touches down at Dobbins Air Force Base, Ga., for Air Force test and evaluation. Scheduled to go into production if it wins AF approval, the JetStar is shown completing a 3-hour, 29-minute transcontinental nonstop flight from California in which it maintained an average cruising speed of 557 mph at a 45,000-ft. altitude.**

## AMC Plans Depot Phaseout

**Before 1958 is over,** five of **Air Materiel Command's** ZI depots will be discontinued as depots and their management responsibilities transferred to the Air Materiel Areas and the two remaining depots.

Only **Dayton** and **Rome AFBs** will remain as full-fledged depots. Except for management functions, however, the depots phasing-out will remain in operation until 1962 as storage, distribution and shipping points. The installations to be closed now manage 230,000 items (20% of the AF total) and provide nearly one-fourth of AMC's total storage space.

## New Maintenance Idea Studied

**A new concept called "disposal-at-failure" maintenance** might reduce the Air Force $4-billion yearly repair bill, **Irvin J. Kessler,** Air Force operational analyst, said recently.

Disposal-at-failure involves replacement of complete assemblies such as electronic subsystems, instead of replacing damaged parts only. Air Materiel Command, taking a leaf from the automotive industry book, has made a few tests of the idea, but little actual experience data is available yet. However, preliminary studies indicate the possibility of big savings, even though initial procurement might be more expensive.

Big drawback—to make savings possible, it would be necessary to anticipate requirements at least three years ahead.

**At McGuire AFB, N.J., a MATS commander observes last-minute weather conditions on the TV receiver in his office (see "Weather Briefing" story above).**

## Pentagon Policies Under Probe

**A special** House Armed Services Subcommittee headed by **Rep. F. Edward Hebert (D-La.)** has begun investigation of Pentagon logistics and procurement policies. The Hebert unit is one of six special subcommittees named by **Rep. Carl Vinson** to continue the full committee's probe of U.S. defenses. Most of the testimony is being given in secret; censored transcripts will be released later.

## Conference Set

**An Army procurement conference** will be held in **Chicago** April 22 to give military procurement personnel a chance to discuss their problems and objectives with Army Assistant Secretary for Logistics, **Frank H. Higgins.** It is the second of three meetings (first was held in St. Louis in March, last is planned for May 13 in Detroit).

# Is the Navy Keeping Pace With Industry?

by Cmdr. R. H. Wilson

*In November 1955,* Fortune *Magazine ran a story which said, in essence, that industry was increasing its productivity approximately 3% per year. The story launched Cmdr. R. H. Wilson, then head of the Supply Department at David Taylor Model Basin, on an effort to find out how his own operation compared. Here is what he discovered . . .*

THE David Taylor Model Basin, near Washington, D.C., is one of the larger research laboratories under the management control of the Navy's Bureau of Ships. Its basic job is the investigation of aircraft and ship design problems. This includes the designing, constructing, and testing of hull and aircraft models and other shapes. The Supply Department must locate, procure, stock and issue the large variety of materials, equipment, and instruments required by all the activity.

In carrying out its assignment, the Supply Department has been streamlining the flow of documents and material to the end-user to improve service at a consistent reduction in costs. (The work units used in the chart are those developed by the Bureau of Supplies and Accounts to measure effectiveness in terms of man-hours expended for work produced.) After six years in the program, the chart shows that representative July-September quarterly output has increased from 45,750 work units in 1950 to 74,496 work units in 1955. The number of personnel performing the supply function has increased from 56 to 60. The result: an increase in employee productivity of 51% for the period, an average increase of 10.2% per year.

Basically, this productivity increase was attained by continual review of the work being performed to develop more efficient methods, and to reassign personnel and responsibilities at the time operations are changed. Here are some specific examples:

**1.** In December 1953, the method of making cash purchases under $100 was modified to make use of the requestor's requisition, as submitted, for completing a purchase. By eliminating retyping the same information on a second document, the issuance of an average 456 purchase orders per month was eliminated as well as the handling of a like number of suppliers' invoices.

**2.** In April 1954, the Model Basin obtained authority to consolidate bulk and shop store quantities of like items and to issue all stocked items not requiring delivery through the use of a one-copy post-posted requisition. This revised procedure resulted in 95% of the issues being made on a one-part requisition, only 5% requiring the preparation of a multiple-copy requisition for delivery. This change made storeroom consolidation possible, released six Industrial Department personnel for industrial production work and also made available one individual in the Inventory Division to fill a vacancy in another department—result: an annual savings of $39,890.

**3.** During the same period the custody and storage-control responsibility for the pool of 9000 instruments used on the station was assumed by the Supply Department from the Industrial Department. Although five personnel are required in providing this service and are included in the "personnel on board" totals shown in the chart, their productive effort has not been reflected in the "work units completed" because no standard work unit has been established for measuring their production.

**4.** During March 1955, the Interstate Commerce Commission extended the Washington, D.C., commercial zone for motor carriers to cover an area which included the Model Basin. This meant motor-transport concerns had to make direct delivery of material consigned to the Model Basin instead of Model Basin trucks making pickups at downtown terminals. During the same period the imprest-fund purchase method was extended to include COD deliveries at the Model Basin by commercial concerns in lieu of in-town cash-purchase pickups. These two changes made it feasible to handle the increased number of procurements and deliveries without an increase in personnel.

**5.** In order to improve service further and to decrease the number of low-value requisitions flowing through the supply and fiscal operations, a pre-expended bin procedure is being established to make available these low-value nuts, bolts, screws and like items to shop personnel on a self-service basis without submitting a requisition.

**6.** When the UNIVAC, with its 2700 items of replacement parts, was

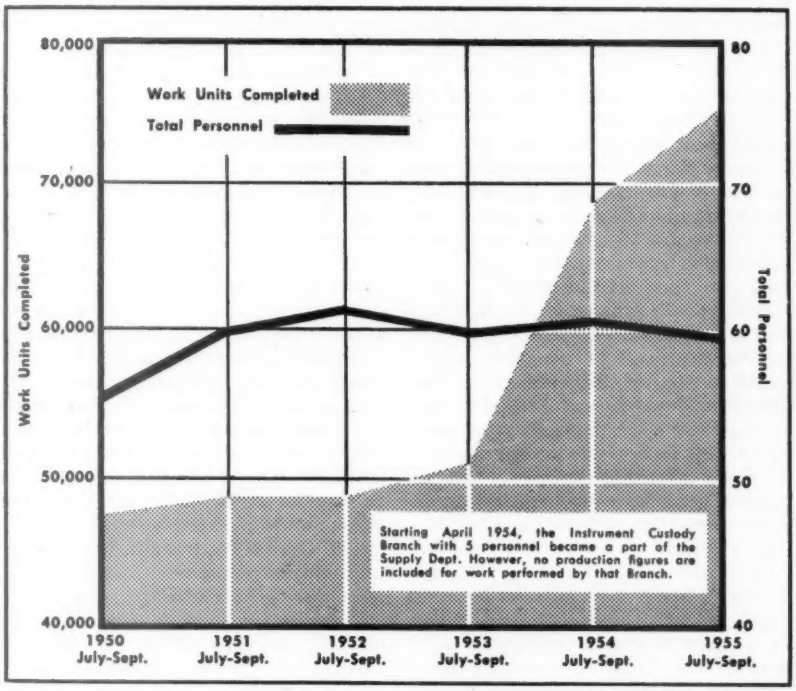
installed in our Applied Mathematics Laboratory Building, the problem arose as to how all of these items could be kept immediately available to the maintenance engineers on a 24-hour basis without losing control for automatic replenishment and effective costing.

The normal method of providing this service would be to locate the items in a storeroom near the UNIVAC and provide a storekeeper to man the storeroom, for each of the three shifts. However, since the volume of issues was low it was felt that the $10,000 annual expenditure for storekeepers was not warranted.

The problem was solved locally by establishing a "tab issue system." Under this "self-service" arrangement, time pulls a "tab" and fills in the account to be charged, quantity withdrawn, and, after signing it, places the tab in a box nearby.

From there the tab is processed through stock control and accounting in the same manner as a regular requisition. After setting up this system, only one-half the time of one employee was required to replenish the bins and tabs.

The above examples indicate how this 10.2% annual average increase in productivity over the past five years was accomplished. Other changes and refinements are in the planning stage. During recent years the Bureau of Supplies and Accounts has developed many streamlined supply procedures




Comparison of work units completed per quarter to total personnel.

an Addressograph plate similar to the example below is prepared for each item:

Account Charged ————————
SOCKET, Pilot Light Assembly
Dial Co. PLN-849-951308-935 Opal
————Qty. ea. Cost .....
86.3850 Code 840 Sig. ————

By reproducing a group of "tabs" for each item and placing them in the bin with the respective item a means is established whereby the maintenance engineer can serve himself quickly and necessary data is furnished for costing and replenishing the items. When the engineer requires a new part, he selects what he needs and at the same which, when applied at activity level, provide increasing employee productivity. Likewise, the Bureau of Ships consistently has stressed the need for an improved end-product at reduced cost. Because of this, it is reasonable to expect that many Navy activities much larger than the David Taylor Model Basin have effected far more significant savings to the Government.

The increase in productivity cited above is small in relation to the Navy as a whole. However, it does give a strong indication that creative thinking and application at activity level are bearing fruit; that the Navy, like industry, is making important strides in increasing its productivity.

*The new amphibious operations adopted by the Marine Corps pose a series of logistical problems. Speed, mobility and flexibility are essential. This is . . .*

# How the Marines Are Solving Their Modern Supply Problems

**by Maj. Gen. Ion M. Bethel**
*Quartermaster General, USMC*

THE primary mission of the Marine Corps supply system is to provide for the adequate and timely logistical support of the Fleet Marine Forces. The character of the supply system is largely shaped by the task of maintaining the Fleet Marine Forces in a condition of readiness—properly equipped and capable of readily moving into a combat situation. Once committed, these forces must be supported over long lines of communication with minimum supply failure.

### About the Author

Major General Ion Maywood Bethel, Quartermaster General of the Marine Corps, began his Marine Corps career as an enlisted man in 1918.

The General was born July 8, 1900, at Mason, Texas, and enlisted in the Marine Corps November 1, 1918. Discharged April 9, 1919, he attended Junior College at John Tarleton, completed his studies there in 1923, and was graduated from Texas A and M in 1925. He re-entered the Marine Corps July 1, 1925, when he was commissioned a second lieutenant.

He became Commanding General of the Marine Corps Clothing Depot (formerly the Depot of Supplies), Philadelphia, on October 1, 1952, when his promotion to brigadier general became effective, and served in that capacity until June, 1955. He became Commanding General, Marine Corps Supply Depot, Albany, Georgia, the following month. He was promoted to major general and assumed his present duties on January 1, 1957.

A new concept of amphibious operations has been adopted by the Marine Corps which is adaptable to small wars or large wars, little wars that develop into big wars and wars which use or do not use nuclear weapons. Speed, mobility and flexibility are the essence of the new concept. While the element of speed has been increased in many ways, of greatest significance is the employment of helicopters in increasing numbers to speed up the initial assault as well as to provide mobility for the tactical units. The helicopter permits the launching of an initial assault while ships are still well out at sea. It makes virtually any point of enemy coastline vulnerable to amphibious assault. Because of its emphasis on speed, mobility and flexibility, the concept demands new equipment, new tactics, new techniques and, of equal importance, a modern supply system geared for immediate responsiveness to the needs of the Fleet Marine Forces.

This new amphibious doctrine of the Marine Corps poses a series of logistical problems, many unique in nature. Some are accentuations of problems incident to the more conventional forms of ground combat. Assembly, embarkation and transportation of the landing force to the objective area does not vary materially from the pattern found to be so successful in World War II. Once in the objective area, however, all is changed, including the logistic philosophy. Troops landing in the assault, whether by helicopter or by landing craft, carry with them only their initial combat supplies. Obviously the amount which they can carry is extremely limited and provision must be made for immediate resupply. To enhance speed and mobility, lift requirements must be radically reduced; yet combat potential cannot be impaired.

The World War II logistic philosophy was to have everything at hand in the objective area in case it was needed. Beaches were stacked high with materiel on the supposition it might be needed. This was a luxury which now, in the nuclear era, cannot be afforded.

Current philosophy calls for obtaining whatever is required as soon as it is needed. Instead of the vast quantities of supplies and equipment stacked upon the beaches, the supply points of the future will be small, self-contained and widely dispersed. Pyramiding of supplies and equipment through all echelons will be eliminated by avoiding the accumulation of large quantities of supplies in the hands of intermediate command echelons, by reducing the size of the common base of supplies and by distribution from the designated support agency direct to the using unit. Wherever possible, using units will be supplied directly and as many intermediate echelons as possible eliminated. Supplies in the objective area will be maintained at a minimum level consistent with the situation. Only a limited automatic resupply will be permitted. Continued support will be dependent upon rapid on-call supply of demands generated by actual conditions within the forward area.

To meet these logistic requirements, the supply system must be immediately responsive to command. Such responsiveness has always been paramount in the management policy of the Marine Corps supply system. Now, however, such responsiveness has become a vital cornerstone of the basic tactical concept of future Fleet Marine Force operations.

Efforts to meet this logistical-support challenge have been based on the premise that effective supply support of the modern Fleet Marine Forces can be obtained only by the most efficient and economical use of available men and materials within a supply system that can be projected overseas when needed. For this reason, maximum effort has been applied to a program of integrating all available manpower and material resources into

a single, homogeneous and streamlined supply management system—a system designed to take full advantage of modern business and inventory management techniques. In many instances, this program has resulted in radical departures from previous concepts.

In the past the Marine Corps supply system was subdivided into five semi-autonomous systems, each sharing total supply management responsibilities along the "classical" commodity lines, *i.e.*, ordnance, engineer, communications-electronics, general property and automotive. Each system, enjoying virtually independent management policy control, operated within its own framework of supply control policies, organization and procedures. In many ways, these individual and diverse supply management systems reflected the various supply systems employed by the numerous technical bureaus, corps and commands of the other three military services through which the Marine Corps procures the bulk of its hardware/weapon material.

The first step in the program of streamlining the supply system was to abolish organizational structures supporting the five individual supply systems. Commodity management corps at departmental and field level were replaced by functional-type organizations encompassing the total range of material required in support of the Fleet Marine Forces and operating under common management direction. The supply and inventory control of the integrated supply system was centralized in two control points. The control of major items has been retained at Headquarters U.S. Marine Corps, while the responsibility for similar control of secondary items is delegated to the Marine Corps Supply Activity located at Philadelphia.

True integration of material inventories and sound supply management requires a single stock-numbering system. This was provided by the Federal Cataloging Program. The Federal Stock Number provided a most efficient means for management categorization of inventories. Both stock and financial reporting systems were converted to Federal Group and Class Reporting. Using the Federal Supply Classification as a standard module, the collection of inventory management data required to insure responsiveness to Fleet Marine Force demands is both flexible and efficient. Diverse management-reporting requirements of the Marine Corps and the numerous higher review echelons are more readily met and with far greater economy.

Management of inventories is based on the fundamental precept that the Marine in the field—the consumer—determines levels of material inventories required for his effective support. Actual usage history, properly identified as "replenishable," has replaced theoretical consumption rates in the computation of stock levels. Frequent review insures adjustment of such levels as demand varies. Inventories are separated into strata (stratified) by purpose on the basis of repetitive demand information and divided (fractionated) by rate of item movement and dollar value for the purpose of reducing system assets to the minimum. By such means excesses have been identified, permitting the acceleration of the redistribution and disposal program. This, in turn, has led to a greater utilization of available personnel and funds for the job of providing better supply support to the Fleet Marine Forces.

Material-input into the supply system is carefully regulated to further the objective of a lean and effective logistic support system. Standardized initial provisioning techniques are being implemented throughout all equipment areas concurrently with end item production. Repair parts, components, and other maintenance items are identified and the range and quantity of actual purchases severely limited. The range is restricted to those items which either are not presently available in the supply system or cannot be purchased more economically from some other source. Quantities of the limited number of items purchased are based on Marine Corps usage of the end item concerned as well as the tactical maintenance concepts under which the equipments will be operated.

Much has been accomplished toward the end of more effectively meeting the logistic-support requirements of the modern Fleet Marine Forces. Major improvements, representing further challenge to management, remain to be realized. For example, initial installations of electronic data-processing equipment are now being made. These installations culminate a long period of research and study conducted to insure that the military potential of this revolutionary aid is fully exploited.

Throughout all the efforts to modernize the Marine Corps supply system the constant objective has been better service to the "consumer"—the fighting Marine in the combat platoon. Care has been taken to insure that this objective has not been obscured by a desire for change solely for the sake of change. Greater economy of men and material with more effective support of the Fleet Marine Forces has been, and remains, the basic goal.

The Marine Corps supply system of this atomic age is still charged with the same basic responsibility of furnishing "beans and bullets" to satisfy the needs of the combat Marine. The nature of the job has been complicated by highly technical modern weapons of war and radically different tactical concepts. As the supply support requirements of the Marine landing forces continue to evolve, however, so must the capability of its supporting establishment. Today, the Fleet Marine Forces stand poised as the Nation's force-in-readiness, a combat-ready amphibious assault force that together with the fleet constitutes an amphibious capability no other nation can match.

**The modern Marine logistic system must be adaptable to the vertically lifted assault.**

# Management in the Army Medical Service

by Silas B. Hays, Major General, MC
*The Surgeon General of the Army*

SINCE 1775, the primary mission of of the Army Medical Service has been "to conserve the fighting strength" —to keep the soldier fit for combat and to return him to duty after illness as soon as possible. It accomplishes this mission in four ways. First, it attempts to select healthy men at the time of enlistment. Second, it tries to keep the men from getting sick through preventive measures such as immunizations, periodic examinations and the application of sanitary controls. Third, when soldiers do get sick or injured, the Army Medical Service attempts to restore them to normal health as soon as possible through the application of up-to-date therapeutic techniques. And, fourth, the Army Medical Service maintains the combat effectiveness of the Army through the disposition of the disabled and chronically ill.

In contrast to the pre-World War II Army, the majority of our officers and noncommissioned officers today are married and have families to support. Because the soldier is separated from his community and often from his family, he has more than normal concern for the welfare of his wife and children. This concern affects his morale and job performance. He needs to be assured that adequate medical service will be provided for his family. By providing family care, the Army Medical Service sustains the morale of the troops. In the past this care was provided only in Army hospitals and dispensaries on a facilities-available basis. Now, in addition to this, Public Law 569, 84th Congress, permits complete obstetrical care and hospitalization of dependents in civilian medical facilities.

While accomplishing its two peacetime missions, the Army Medical Service must prepare to support the Army in time of war. This preparation must be continuous, intensive, and real. It is best accomplished during times of peace. It requires much planning, organization, medical research, education and training, stockpiling of medical supplies and equipment, and construction and rehabilitation of medical facilities.

This description of medical missions points up a unique characteristic of the Army Medical Service, namely the personal and professional nature of its service. The Army Medical Service is concerned with the soldier as a soldier and as a human being, frequently when he is ill or emotionally upset. In every instance, he must be given individual consideration.

The Army Medical Service is currently responsible for providing medical care for approximately a million men and an equal number of dependents. It operates 217 dispensaries, 97 hospitals, 17 laboratories (medical and dental), and 73 examining stations. With approximately 30,000 military and 14,000 civilian personnel, it serves approximately 60,000 outpatients and 16,000 inpatients daily.

The conduct of medical service operations, Army-wide, requires the application of the same principles of management which have been so frequently described by other commanders on the pages of this journal. The difference lies in emphasis and in practices peculiar to the special nature of the medical mission. Application of management principles requires that the Army Medical Service have:

(1) Adequate plans and programs;
(2) Efficient and flexible organization;
(3) Adequate resources;
(4) Efficient and economical operations;
(5) Continuing analysis of operations in order to improve performance

These requirements are similar to those in any other military organization. The successful operation of the Army Medical Service, however, requires a high degree of coordination of the efforts of many medical activities. It is essential, therefore, to centralize board planning, policy formulation, and control of those operations which serve the Army Medical Service as a whole.

**Planning** consists of two major efforts—one for peacetime operations and the other for the combat support of the Army in the field. In its annual *Program Document*, the Army Medical Service sets forth the objectives, policies, factors, trends, and schedules of workload and resources for the major medical programs required to provide medical service to the Army worldwide. The resource requirements for accomplishing the various programs are translated into financial terms in the Operating Budget. The second type of planning deals with the development of doctrine, tactical organization, and methods of supporting the combat forces in different types of emergencies and in general war. The threat of nuclear warfare and the possibility of mass casualties on an unprecedented scale pose formidable medical problems. They require the exercise of imaginative thinking and close working relationships with other military and civilian medical agencies.

**Organization** provides the means for bringing together men and resources in an integrated and coordinated fashion in order to perform the work necessary to achieve the designated objectives. The Army Medical Service exists to support the Army. At Department of the Army level, The Surgeon General reports, together with other Chiefs of Technical Services, to the Deputy Chief of Staff for Logistics. However, on very important matters relating to the health and medical care of troops and utilization of professional medical personnel, The Surgeon General has direct access to the Chief of Staff of the Army. In the discharge of his responsibilities, The Surgeon

General has a dual role. He is a staff officer, the Chief Medical Adviser on the health of the Army; and he commands a number of medical facilities which have special missions. As a staff officer, The Surgeon General provides guidance to all commands on objectives, policies, and operations through the Army Medical Service Program Document and Department of the Army directives.

While programming, budgeting, and organization planning are centralized at OTSG level, operations are decentralized to the greatest extent possible in order to make the Army Medical Service responsible to local needs and to operate with maximum efficiency. This is accomplished within the organizational framework of the Army by placing only a few medical facilities under The Surgeon General, and the great number under CONUS army and oversea commanders. The hospitals directly under The Surgeon General serve as specialized treatment centers for patients evacuated not only from the Continental U.S. but from every place in the world where Army troops are serving. They also provide medical care to troops stationed in the vicinity of the hospital. The dispensaries and station hospitals provide the great bulk of local medical care to the troops and their families; and this care is of a general short-term nature of about nine days average duration.

Only about 7 percent of patients from these hospitals are transferred to the specialized treatment centers for long-term definitive care. These transfer cases generally present difficult and complex medical conditions, or require formidable surgery not readily available in small hospitals. In addition to operating a few hospitals, The Surgeon General also operates the Walter Reed Institute of Research, the Army Medical Service School, a Medical Training Center, and three medical research laboratories.

The procurement, distribution, and proper utilization of medical resources in a manner which will prevent imbalances among the major programs are important functions of management. The principal element is personnel. Approximately 80 percent of the operating cost of Army hospitals is accounted for by personnel. Furthermore, many categories of this personnel are of a high professional caliber which is in scarce supply. Accordingly, considerable effort is made to achieve the best possible utilization of medical personnel. Manning guides, staffing standards, and manpower surveys are utilized as means of control. Special limitations are imposed by Department of Defense on the procurement of physicians and dentists. The procurement of nurses is limited by a national shortage. Because of the limited availability of such personnel, distribution has to be accomplished with care and with regard to effective use of their special talents.

Key positions, held by Army surgeons, hospital commanders, and chiefs of professional services and administrative divisions in hospitals and other medical units, are filled by carefully selected and specially trained officers. Such officers are given extensive training and are placed in assignments carrying progressively more responsibility and diversity of functions. Continuous inservice training is conducted for all types of personnel in service schools, hospitals, and civilian institutions. One of the most fruitful postwar programs has been the training of medical interns and residents.

The provision of adequate medical treatment facilities is an important factor for providing high standards of patient care. A considerable number of existing hospital and dispensary structures are of a temporary nature, constructed in World War II, and for a size and type of operation which was very different from current requirements. A program is under way to replace old and temporary buildings at permanent posts with modern-type medical facilities. Two new hospitals have been completed, one at Fort Knox, Kentucky, and one at Fort Belvoir, Virginia. Five other hospitals are under construction. Several are in the planning stage.

The availability of adequate medical supplies and equipment is indispensable for medical care. Proper levels are maintained at posts, camps, and stations to insure continuance of medical service operations. A number of critical items and those with a long lead in production are stockpiled as mobilization reserve. Procurement, storage, and distribution of medical supplies is now under a single Department of Defense manager, the Navy Department. The Medical and Dental Division of the Army Stock Fund is utilized to provide bulk supplies to the stations in CONUS and overseas.

**Financial management** in the Army has been receiving considerable attention in the past few years, and there have been many developments affecting the Army Medical Service. The first extended implementation of the Army Stock Fund was in the management of medical supplies and equipment, and this began 1 July 1953. Since that time, other elements of the Army Financial Management Plan have been applied to medical service operations, including consumer funding, integrated accounting, financial inventory accounting, and cost accounting. A Medical Command Management System has been developed as a component of the Army's broader Army Command Management System.

**Direction and coordination** of medical service operations in the Army is accomplished by The Surgeon General in various ways. Direction and guidance of operations for each fiscal year is provided through the Army Medical Service Program Document. Additional guidance is issued in the form of Army regulations, medical bulletins, technical manuals, and staff correspondence. Assistance is provided through staff visits. Coordination is also promoted through periodic conferences with Army command surgeons and with commanders of Class II hospitals and medical centers under The Surgeon General. Through these contacts, an awareness and understanding of

field problems is gained and better direction is provided; key medical officers are informed of recent developments at Department of Army Headquarters and are acquainted with the overall problems of the Army Medical Service. This two-way communication provides a better understanding of objectives, policies, and practices; it serves to enhance the morale of medical personnel in the field.

Closer and more detailed direction of medical service operations is provided by the CONUS army and oversea commanders. Each commander has a "Surgeon" on his staff who provides advice and guidance on medical matters.

Coordination is also effected with other military medical services in matters relating to joint planning and joint operations. Medical regulating of patients evacuated from overseas and within the CONUS is coordinated by a joint agency called the Armed Services Medical Regulating Office (ASMRO), which operates under the supervision of the Army Surgeon General. Cross-servicing and joint utilization of medical facilities permits personnel of one military service to receive care from another when it is indicated by patient consideration or economy. Procurement of medical supplies and equipment is now made by the U.S. Navy for all three military medical services. On the other hand, the implementation of care in civilian facilities authorized by the Dependents Medical Care Act, PL 569, 84th Congress, is administered by the Army Surgeon General for all three military departments, the U.S. Coast Guard, U.S. Public Health Service, and the Coast and Geodetic Survey.

**Control** of medical service operations is in many respects different from that of other Technical Services because the personal and professional nature of its service greatly outweighs the medical supply function. The Army Medical Service has many special and unique problems and is subject to special controls by higher authority such as Congress, the Office of Defense Mobilization, the Bureau of the Budget, and the Department of Defense. The health of the Army depends upon the close integration of preventive and therapeutic measures throughout all echelons of command. Hospitalization and evacuation of patients must be closely coordinated with parallel services of the Air Force, Navy, VA, USPHS, and civilian medical facilities.

The segregation of medical problems at different levels of government precipitates special controls that are extended throughout the Army. For these reasons, the assignment of medical service officers is carefully controlled to make the most effective use of their talents; staffing ratios are imposed which limit the availability and control the utilization of manpower; personnel and cost reports are submitted at regular intervals to higher authority and the Bureau of the Budget on medical treatment facilities; restrictions are imposed on the size, type, and location of new hospitals and dispensaries; special technical reports are submitted by field agencies to Department of the Army on the care of patients and utilization of facilities and resources. Since the Army Medical Service is part of American medicine, it shares in the medical manpower available to the nation. It adheres to national standards of medical practice and hospital accreditation.

From the foregoing, it is evident that controls are of two types—administrative and professional. **Administrative controls** relate to plans, program, operations, and medical resources.

**Professional controls** are pre-eminently important to insure that high standards of medical care are maintained at each medical treatment facility.

Special care is exercised in selecting applicants for commission in the Regular Army Medical Corps. Three of the important criteria require selection of applicants generally from the top third of their class; that they possess good character; and that they be in sound physical condition. High standards of medical practice are maintained through regular review of professional work by the medical staff, by civilian consultants, and by medical examiners of the Joint Commission on Hospital Accreditation.

However, the quality of medical care depends also on other factors, and it can be maintained only by achieving acceptable standards in these other factors, too. They include adequate facilities, adequate support staff, and sufficient supplies and equipment. One of the most meaningful indexes of health in the Army is the noneffective rate, which represents the average daily number of military personnel per 1000 strength who are sick and not available for duty. This rate has dropped markedly in the past five years from 20 per 1000 troops in 1953 to 12 in 1957. The impact of this change can be illustrated by the following example. The decrease from 1955-1956 in the noneffective rate was only .2%; yet it represents a reduction of 79,000 lost man-days. This is equal to having a company of 216 men available for duty for a whole year. The trend of reduced noneffectiveness means that more and more men are being kept on the job. Several factors are contributing to this improvement: (1) emphasis of treatment on an outpatient basis; (2) decrease in length of hospitalization due to more intensive medical treatment and improved administrative practices; (3) maintenance of high standards in the initial selection of personnel for induction (approximately only 65% quality); (4) an effective preventive medicine program; and (5) use of the latest therapeutic drugs and techniques.

Finally, a continuing function of management is the improvement of performance. Through inspections and analysis of operations, problem areas are detected which merit detailed study. A continuing professional and administrative research program is being conducted. It includes projects for the improvement of medical supplies and equipment and for the discovery of new or better ways to operate medical facilities and make more effective use of available resources. Through all these means, the Army Medical Service strives to provide for the American soldier the best possible medical care that available resources, personnel and facilities will allow.

*Electronic-equipment reliability is vital to the defense effort. Better equipment today means the proper application of today's component parts. This is . . .*

# The Key to Reliability Improvement

**by Karl F. McCready**
*Northrop Aircraft, Inc.*

AN awareness of the role reliability plays in the effectiveness of the defense effort has become acute among the Military Services and throughout the electronics industry. Considerable attention has been directed toward refining procedures for measuring and predicting the reliability of electronic equipment.

The purpose of this presentation is not to suggest refined procedures for reliability measurement or prediction; for irrespective of the measurement procedure, the answer is essentially unchanged: the reliability of present-day electronic equipment leaves much to be desired.

The fact that reliability must be improved has been emphasized to such a degree that it has become a real challenge to find a new or original mode of emphasis. I will not accept the challenge. Instead, an attempt will be made to illustrate some procedures that can be used to improve electronic-equipment reliability.

If an electronic-equipment design engineer is asked what makes the equipment he designs so unreliable, he will likely reply that the component parts he must use are unreliable. Considering the complexity of modern electronic equipment, one is inclined to sympathize with the design engineer or admit that the task is impossible. The importance of electronics in the defense effort, however, precludes an overindulgence in sympathy or an attitude of defeatism.

The design engineer is partially correct. Certainly if there is to be a day when reliable electronic equipment exists as reality, then it will be when the small irreducible parts used to fabricate electronic equipment approach perfection.

If reliability is to continue to improve, then component parts must be improved. Many agencies within the military and industry are active in developing improved parts. Future electronic equipment will be more reliable because improved parts will be available. But in the desire to have improved parts, let us not overlook one important fact. *We must improve the reliability of electronic equipment today while using the parts that are available today. Our progress must not be contingent on miracles.*

To illustrate the point, consider the story of Cinderella. Apparently, the only thing that had prevented Cinderella from marrying a charming prince was the fact she had never met one. One does not have to wonder as to Cindy's outcome if she had complacently waited on her ash heap for a fairy godmother who did not make her existence known.

Since the objective was to meet a prince, it has often occurred to me that Cinderella would have met one perhaps three years sooner if she had chosen to attend a masquerade party disguised as Cinderella rather than a grand ball disguised as a princess. In this event she could have gone as she was, not requiring any miracles. The result would have been the same, if we are to believe in love at first sight, except that she would have had her prince sooner. The moral of the story is: We must get off our ashes and make the best of what we have. Miracles are for fairy tales.

Once it is recognized that component-parts improvement will not occur in a miraculous fashion, only one approach remains to those who will improve electronic equipment reliability today—proper application of currently available parts. The reliability improvement that will be measured in the near future will depend upon the efforts of electronic design engineers to develop parts-application techniques that will maximize the success probability of every part used in each design. The reliable circuit that is unreliable because of the unavailability of reliable parts does not exist except in the imagination of naive engineers. One operating prototype fabricated from carefully selected parts does not constitute a sound basis for assuming a reliable design.

To make the best use of available parts, to assure their proper application,

| | | $W_1$ | $W_2$ | $W_3$ | | |
|---|---|---|---|---|---|---|
| $S_1$ | $K_1$ | 612<br>828 | 1446<br>922 | 165<br>353 | $T_4$ | |
| | $K_2$ | 487<br>693 | 627<br>1497 | 455<br>205 | $T_5$ | |
| | $K_3$ | 575<br>464 | 1405<br>710 | 567<br>297 | $T_6$ | $T_{14}$ |
| | $K_4$ | 809<br>1224 | 1164<br>1205 | 896<br>1565 | $T_7$ | |
| | $K_5$ | 1205<br>1087 | 990<br>1437 | 1387<br>233 | $T_8$ | |
| $S_2$ | $K_1$ | 1206<br>1107 | 1038<br>1353 | 253<br>300 | $T_9$ | |
| | $K_2$ | 1642<br>803 | 1705<br>1740 | 232<br>542 | $T_{10}$ | |
| | $K_3$ | 1004<br>794 | 1035<br>1044 | 1514<br>518 | $T_{11}$ | $T_{15}$ |
| | $K_4$ | 1326<br>682 | 1578<br>1075 | 625<br>391 | $T_{12}$ | |
| | $K_5$ | 1177<br>1459 | 1968<br>1705 | 1321<br>1507 | $T_{13}$ | |
| | | $T_1$ | $T_2$ | $T_3$ | T (GRAND TOTAL) | |

**Fig. 1. Experimental data.**

design engineers must develop a better appreciation for the inherent variability in nature. They must comprehend the application of statistical principles and techniques to the problems of equipment design.

It is impossible here to present more than a glimpse of the potential use of statistics in improving the application of electronic parts. However, two

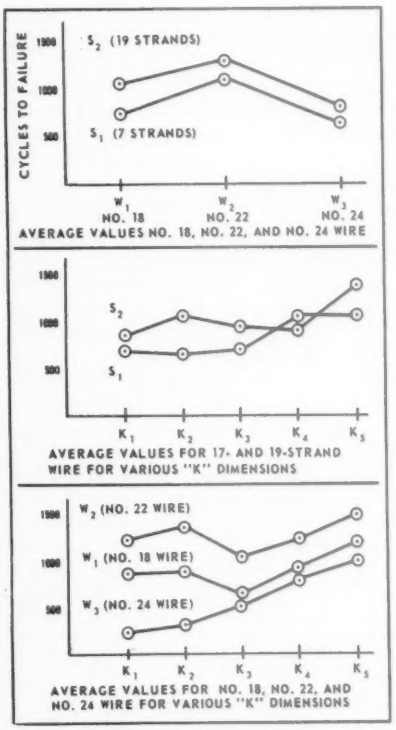



**Fig. 2. Graphical presentation of results.**

techniques will be discussed that have been successfully applied to a number of practical problems.

Many variables influence the proper application of parts. Establishing the relative importance of the different variables presents a formidable problem to the design engineer. The classical approach to experimentation is to hold all variables, except one, constant and study each variable in turn to establish its effect on the application. The prohibitive cost in both dollars and testing hours of following a classical approach has led to the adoption of statistical experimental design for isolating the significant variables.

The statistical approach permits the design engineer to study the effects of the individual variables as well as interaction effects with a saving in both time and test-sample size.

Here is an example. In an investigation of wire-breakage problems, three variables were considered in an exploratory factorial experiment on wire life under flexure.

The variables considered were:

a. *Wire size:*
   $W_1$ = #18 wire
   $W_2$ = #22 wire
   $W_3$ = #24 wire
b. *Wire stranding:*
   $S_1$ = 7-strand wire
   $S_2$ = 19-strand wire
c. *Length of unsoldered uninsulated wire above the solder cup (dimension is defined as "K"):*
   $K_1$ = 0 inch
   $K_2$ = .031 inch
   $K_3$ = .062 inch
   $K_4$ = .093 inch
   $K_5$ = .125 inch

The purpose of the experiment was to determine the effects of the three variables on flexure life with the number of flexure cycles-to-failure as the criterion of performance.

Using a three-factor design, the experiment was arranged as indicated in Fig. 1.

Each number in the cells of Fig. 1 represents the number of flexure cycles-to-failure for one wire. For example, two #18 7-strand wires with a K = 0 were tested to failure as indicated by the cell in the upper left-hand corner of Fig. 1. One failed after 612 cycles and the other after 828 cycles. Each cell represents a different combination of the 3 variables for a total of 30 combinations or 60 wires.

A wire-flexing fixture was designed to flex 10 wires at a time. The totals indicated in each row and column as T are the total flexures for the respective row or column. For example, $T_1$ is the sum of the flexures-to-failure for all #18 wires and $T_{14}$ is the sum of the flexures-to-failure for all 7-strand wires.

Figure 1, then, represents the raw data obtained during the experiment. From these data, using analysis of variance techniques, it was possible to study the individual effects of wire size, wire stranding and K-factor on flexure life. In addition to the individual effects, it was also possible to examine the interaction effects of the 3 variables.

In performing an analysis of variance, it is hypothesized that the observed variation in flexure life occurs as a result of chance rather than as an effect of the treatments considered. By means of an "F" ratio (a critical significance ratio of the systematic variation of the treatment effects to the random experimental error), the validity of the hypothesis is tested.

The validity of each hypothesis can be determined by comparing the "F" ratios obtained from the experiment with the values listed in an "F" table.

For example, the probability is less than one in 1000 that the variations observed in flexure life for different wire sizes are due to chance. Likewise, the probability is less than one in 1000 that the variations observed for different wire strandings is due to chance. The variation in flexure life with dimension K has a probability of less than 1 in 100 of being due to chance.

On the other hand, the variations in flexure life as a result of the interaction effects of the variables in combination (wire size, stranding and K dimension) are due to chance alone.

It is frequently useful to graph the results of a factorial experiment such as this. The meaning of "interaction" (or lack of it in this case) thereby becomes clearer.

Fig. 2 shows three graphs of the significant effects (those not due to chance) of wire size, stranding, and dimension K.

It can be observed from Fig. 2 (graph 1) that 19-strand wire is superior (longer-lived) to 7-strand wire for all wire sizes.

In graph 2, 19-strand wire is superior except for K-dimension $K_4$. However, the "F" ratio for the K-S interaction effect shows this to be due to chance variation within the framework of experimental variation. Graph 3

shows no wire size K-dimension interaction.

It is, therefore, possible to draw the following conclusions:

1. The optimum wire size is #22 wire.
2. 19-strand wire is superior to 7-strand wire for applications simulated by the test conditions.
3. Flex life is greater for longer lengths of unsoldered uninsulated wire above the solder cup.
4. There is no significant interaction among the three variables considered. Therefore, each of the first three conclusions can be considered true.

The measure of experimental variation is also available as the square root of the "error mean square." This is the type of variation that the classical experimenter attempts to measure by "holding everything constant." Thus it is possible, through the application of mathematical processes, to obtain information that would be prohibitively costly if the "brute force" iterative procedures of classical experimentation were employed.

Although the example described an experiment that was designed to choose the optimum wire and method of applying the wire, the technique is applicable to many parts-application problems. Many different statistical formats are available in the literature which may amplify or alter the technique illustrated.

One of the common problems that confronts the design engineer is that of the part specification. The specification controls certain parameters under the specific test conditions of the specification. The design engineer seldom applies the part under the specific conditions of the specification tests. Although there have been equipment manufacturers who have attempted to get the parts specifications written around the operating conditions of their equipment, it is obvious that some restriction must be placed on the number of test conditions that can be specified for each part.

Fortunately, it is not necessary that every possible set of operating conditions be specified in the parts specification. If the design engineer can establish a high degree of correlation between the operating conditions in his equipment and the test conditions in the parts specification, he can determine whether or not the part is adequately controlled for his application. This can be done by applying regression analysis techniques.

An actual problem will serve to illustrate the technique.

A design engineer was concerned over the suitability of the JAN 6080 electron tube for use in a voltage-regulator circuit. The application used several JAN 6080 tubes in parallel with a combination of fixed and self-bias. The military specification for the JAN 6080 specified a self-bias test only. Self-bias tends to minimize the difference in plate current between the two sections of a tube when the sections are connected in parallel.

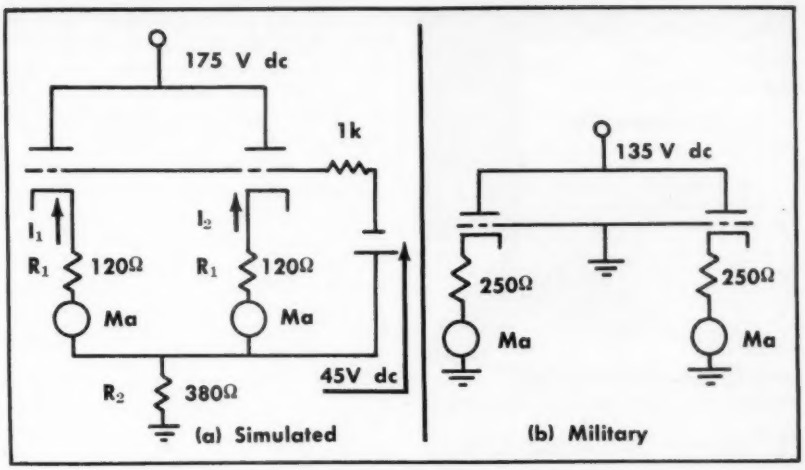



Fig. 3. Simulated and military tests.

The military specification for the JAN 6080 tube specified a minimum plate current of 100 milliamperes and a maximum plate current of 150 milliamperes under the self-bias conditions of the test. It further stated a maximum plate dissipation of 13 watts per plate.

The design engineer was concerned about the following:

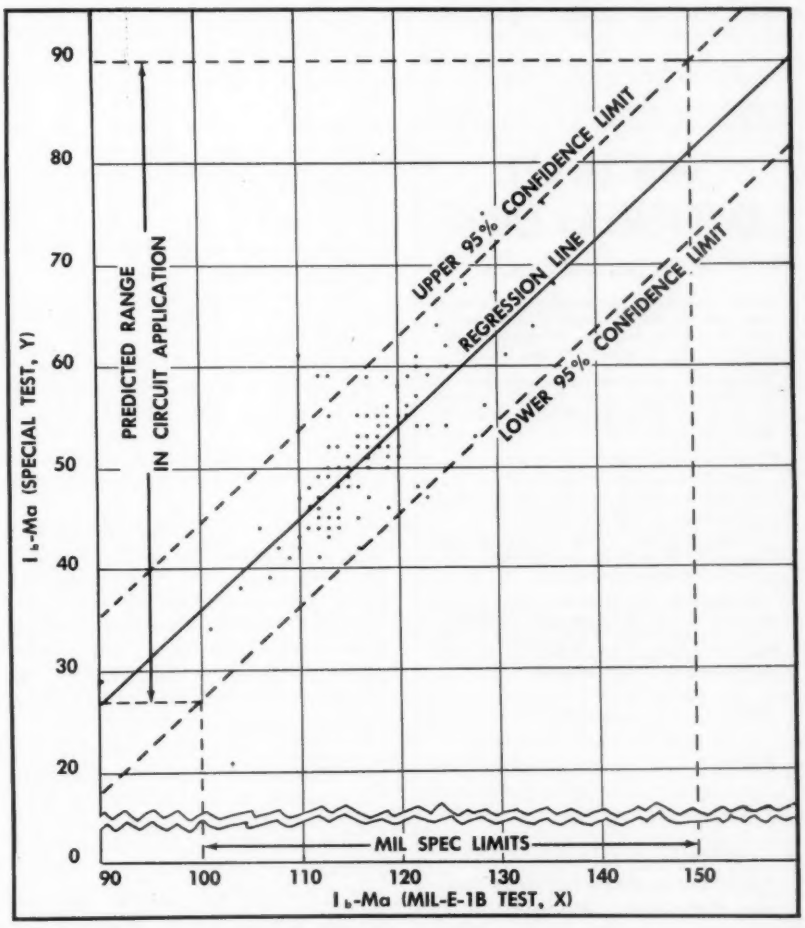



Fig. 4. JAN-6080 Mil-E-1B Plate Current Test vs Special Plate Current Test.

1. If both sections of the JAN 6080 tube read 150 milliamperes under the military test conditions, what plate current would be drawn in his circuit? Would the rated plate dissipation of 13 watts per plate be exceeded?

2. If a JAN 6080 tube displayed the maximum plate current unbalance permitted by the military specification (100 Ma. on one plate and 150 Ma. on the other), what plate current would be drawn by each plate in the application, and would the maximum rated plate dissipation of 13 watts per plate be exceeded?

3. Is it necessary to use a special plate current test and, if so, what limits should be set to pick tubes for the application?

To answer the design engineer's questions, a test was designed to duplicate the operating conditions of the application.

Fig. 3a shows the test circuit used to simulate the application. It should be noted that a combination of fixed and self-bias was used. Fig. 3b shows the standard military test circuit where only self-bias is employed.

Sixty JAN 6080 tubes were tested first in accordance with the military specification then in accordance with the special test conditions.

The data obtained are plotted in Fig. 4. In analyzing these data, the plate-current values obtained for the conditions of the military test (MIL-E-1B) were considered as the independent variable X. The plate-current values obtained for the special test conditions were considered as the dependent variable Y.

The objective of the analysis was to determine if a significant relationship existed between plate current measured by the standard military method and the plate current that existed in the application. The existence of such a relationship provides a basis for predicting the behavior of JAN 6080 tubes when operated under the specific conditions of the application.

The linear relationship observed in Fig. 4 suggested the use of a simple linear regression line to describe the data. This method permits the "best" prediction of a dependent variable from a knowledge of an independent variable. "Best" in this sense is the minimum squared deviation values from the computed regression line.

From Fig. 4 it was concluded that the minimum plate currrent that could be expected in the application is 27 milliamperes. The maximum plate current that could be expected was concluded to be 90 milliamperes.

Referring to Fig. 3a, the plate dissipation for each tube section is calculated from the following expressions:

$$P_1 = [175 - I_1 R_1 - (I_1 + I_2) R_2] I_1$$
$$P_2 = [175 - I_2 R_2 - (I_1 + I_2) R_1] I_2$$

The maximum plate dissipation occurs in the application when one section of the tube is at the maximum limit for plate current and the other section is at the minimum limit. The maximum plate dissipation will occur in the section that is conducting most heavily.

Applying the formula for plate dissipation to this case, $P_{max}$ is 9.8 watts. This is well within the 13-watt maximum rating for the JAN 6080 tube.

By applying the technique of regression analysis, it was possible to predict the performance of JAN 6080 tubes in this particular application. It was determined that the military specification test conditions were adequate. It was not necessary to introduce a special inspection test for tubes used in this application.

The expression, "A chain is no stronger than its weakest link," has been used on many occasions to highlight the need for better electronic parts. In closing, I would like to interject the opinion that chains break most frequently because they are overloaded.

**Acknowledgements:**

**The author would like to express thanks to Gordon G. Ross, Michael Leppanen and David E. Conklin of the Northrop Missile Guidance Reliability Section for their assistance.**

## Dates to Circle

**April 14-25**

National Resources Conference—being held concurrently in Rochester, N.Y., and Fort Worth, Tex.; sponsored by the Industrial College of the Armed Forces.

**April 22-24**

Electronic Components Conference —Los Angeles, Calif.; sponsored by Electronic Industries Assoc.

**April 28-30**

2nd Annual Astronautical Symposium —Denver; sponsored by the Air Research and Development Command and the Institute of the Aeronautical Sciences.

**May 15-16**

Armed Forces Management Assoc., Fourth Annual Conference—Pentagon, Washington, D.C.

**May 26-28**

National Office Management Association Conference—Conrad Hilton Hotel, Chicago; sponsored by NOMA.

# Problems In Technical Publication Management*

Second in a Series
by Roswell Ward

*Technical Publication Management Consultant*

IN THE FIRST article of this series (ARMED FORCES MANAGEMENT, March) the term "danger areas" was used to indicate those aspects of publication management in industry where difficulties most frequently occur. One of the objects of management engineering is to establish a series of standards by which management at all levels can make realistic judgments as to their particular operation. At present there is very little published information available that management engineers can "go on" in analyzing the operations of a technical publication department.

If there has been difficulty in the operation of the department, the problem is to ascertain the cause of the difficulty; then compare the procedures used with the management consultant's experience of successful operations in other organizations; then work out a constructive solution to the problem.

In my experience the "danger areas" are those spots in publication management where a troubleshooter is most frequently needed. However, if top management requires a general survey of publication activities, these trouble areas can well be called "evaluation areas," as they are those aspects of publication work which are the most sensitive to variations in management procedures.

The object of most good management engineering is to reduce costs, improve quality and improve service. In general these criteria should be used by top management in analyzing the work of their publication department. However, it is necessary to go behind these generalities and examine typical situations in which better management can produce better results.

## Problem Area No. 1

The basic problem is inexpert supervision by top management. In using the term "top management," I mean the highest level of executive who makes policy, budget or other administrative decisions in regard to his company's publication activities. In this article, as in the previous one, the term "technical publications" means primarily various types of instruction books supplied with equipment for the Armed Forces. Most of the management problems defined here also have an application to departments producing other types of technical publications and reports for either military or civilian use.

Inexpert supervision by top management is illustrated by the following case study, which is a composite of several situations observed in typical defense plants.

Company X21 had undergone rapid expansion and considerable turnover in top management personnel due to key executives reaching the mandatory retirement age. In respect to the publication department the following problems were observed:

1. The two men—president and general sales manager—who made final decisions in regard to publication activities were so preoccupied with the idea that they should avoid involvement in "administrative detail" and that they should delegate both complete authority and responsibility to subordinates, that they carried this procedure to an extreme.

As a top management philosophy, avoidance of detail and delegation of authority and responsibility are highly to be desired. However, this can be carried too far and, if so, is probably an indication of two things—an escape mechanism to avoid adequate study of complex problems; or top management's failure to ascertain whether subordinate executives are qualified to make recommendations regarding their publication-department activities.

2. Some examples of top management errors found in the survey of Company X21 were as follows:

a. Refusal to sanction the reorganization of the company photographic department to include a competent technical photographer, an absolute essential for good publication work.
b. Insistence on the use of *one* specific outside technical writing service, apparently selected on the basis of personal friendship with the president of the company, rather than on the basis of qualifications to do the work required.
c. Insistence that special forms and cost-accounting procedures for the publication department be abandoned in favor of the "regular cost records," which were completely unsuitable for publication costs analysis.
d. Refusal to permit the publication staff to receive mail at the office from technical writing, engineering and other professional societies.
e. Refusal to include the company technical writers in their engineering, communication and product training programs.

3. In the case of Company X21 the management group had placed the publication manager too far away from top management. In doing so they had entrusted the chain of command to three executives who knew little or nothing about publication work. These intermediate executives did not wish to admit that they were limited in their knowledge of publication problems. They rationalized this viewpoint by making another serious mistake.

4. They down-graded the publication department and its work to something akin to a clerical routine required only to fulfill contracts. Essentially, they regarded instruction books as a necessary evil and nothing more. Hence, by virtue of ill-considered decisions, they were constantly hampering the activities of a relatively well qualified publication manager. It is not a rare occurrence in industry to fail to recognize the importance of instruction books for both internal and external use, in engineering, sales and field-service relationships.

Some mistakes were therefore made in top management decisions affecting the publication department, which in turn affected operating costs. These decisions also produced a bad case of seriously impaired morale among the publication department staff members.

## Solving the Problem

Top management should have expert advice in regard to all phases of publication activities. Only experience can assure the development of instruction books which can not only pass government specifications but which can also be a really constructive educational service to the personnel of the Armed Forces. Only the publication manager or an executive who has had comparable recent experience can competently advise on the development of specialized procedures for planning, scheduling and keeping track of every phase of the production of instruction books, as well as developing the best possible working conditions.

The management of the company either needs to learn something about the essentials of good publication work, or they need to assure themselves that they are basing their decisions on the recommendations of various executives who *should be competent* to pass on publication work.

There has been a great deal of dis-

cussion and a certain amount of indoctrination within industry in developing improved "communications," largely within the manufacturing organization. An executive may be quite adept at reaching a degree of communications efficiency in internal relationships but he can be absolutely at sea in regard to matters concerning the writing, editing, illustrating and production of instruction books for use by the Armed Forces or by civilian customers.

As a result of the situation in Company X21 the following recommendations were made:

1. Make an objective evaluation of the publication supervisory qualifications of members of the management team who are concerned with the publication department.

2. If there are deficiencies in the team's ability to competently pass on publication work, an indoctrination course should be developed for them, or the organization structure changed so that the publication manager reports direct to top management.

3. Every effort should be made, in dealing with all levels of management, to impress all concerned with the fact that facility in routine business communication does not necessarily imply ability to exert supervision over publication activities. There is a great deal more involved in instruction-book preparation—particularly in contract negotiation, adherence to complex specifications, planning, editing, writing and illustrating of such books—than there is in the preparation of any ordinary-type industrial communication.

An instruction book is not just a routine publication developed only to meet contract requirements. Neither is it a necessary evil which can be viewed in the same dim light as many older railroad men regarded the preparation of timetables. A good instruction book should enlist every resource of the writer, the editor, the illustrator and the publication production specialist so as to be a real printed and graphic "teacher" of military or civilian personnel in the operation, repair and overhaul and spare-parts supply of military hardware or civilian equipment.

In such an effort, top management must recognize the need for competent supervisory personnel. Top management must also regard publication management as a highly specialized profession, comparable to the specialized status of other professional men in industry—the lawyers, accountants, engineers, research administrators and labor-management experts.

The next article in this series will discuss the qualifications needed for a successful publication manager in industry.

## MUTUAL FUNDS IN A DECLINING MARKET

**by W. Mac Stewart***

We all know that the stock market declined sharply in the latter part of 1957. This has prompted a number of questions as to how mutual funds fared in this market drop. How did fund investors come out as compared with the average do-it-yourself investor? And is this the right time for investing in a fund?

Let's look first at what happened to the market. After reaching a high in July, it began a sustained decline which, except for brief upturns, has lasted into 1958.

As measured by the accepted indexes, the market actually dropped 13 to 14½ percent. But what about individual issues? Of the 1005 common stocks listed on the New York Stock Exchange, nearly *half* were down 20% or more; nearly a third were down 30% or more; nearly a hundred of them were off over 50%. Which stocks should the investor have selected?

Let's look at a few of the well known stocks: National Steel? Down 32%. United Airlines? Down 46%. Missouri Pacific? Down 49%. Anaconda? Down 44%. Boeing? Down 36%. General Motors? Down 24%. Ford? Down 31%. And so the list goes. Of the 20 most widely held stocks, 15 were down. Perhaps the answer was to invest in "national defense" stocks? Of the 96 leading stocks in that category, 85 were down more than 20%.

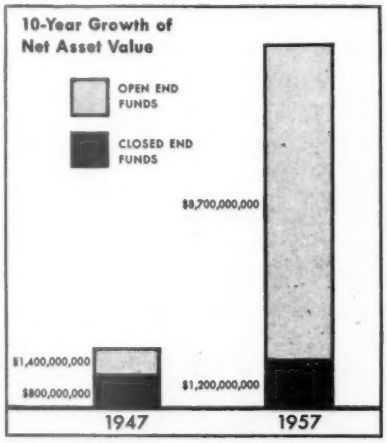
What happened to common-stock mutual funds in this same period? Well, like individual issues, some were down more than the market in general, some less. Generally, the funds that declined faster than the market were those specializing in specific industries or in growth stocks. Many of the "middle-of-the-road" funds, which strive for both income and growth, declined about the same, or less than, the market. Some of the funds which hold a cash position were in a very advantageous situation. One fund, for example ("A" in the chart below), had built a position of over 20% cash by July of 1957, when the decline started. You will note from the chart that that cash position not only cushioned the drop, but enabled the fund to purchase millions of dollars of securities at lower prices when the market was down. This resulted in faster recovery.

This chart compares the market action in 1957, as measured by the two leading market indexes, with six major common-stock investment funds. The first column shows the decline during the year; the second, the net decline from the first of 1957 to February 1, 1958. The latter figure takes into consideration the minor market recovery that took place during January. All figures include security profits paid by funds during the period:

| Index or Fund | % of Decline 1/1/57-1/1/58 | Net Decline 1/1/57-2/1/58 |
|---|---|---|
| Dow-Jones Industrial Average | 13.0% | 9.1% |
| Standard & Poor's 500-stock Index | 14.6 | 9.9 |
| Fund A | 11.6 | 7.1 |
| Fund B | 11.8 | 7.4 |
| Fund C | 13.5 | 11.1 |
| Fund D | 13.8 | 9.2 |
| Fund E | 15.4 | 10.0 |
| Fund F | 16.6 | 11.2 |

Bear in mind that all these funds also paid ordinary income dividends every quarter during this period—some of them the highest dividends in their history. So you can see that, in general, high-grade common-stock funds fared about as well, or better, than the market as a whole during the decline.

As this column has previously pointed out, this year should be an excellent time to make lump-sum investments in carefully selected common-stock funds or balanced funds holding




**In the last ten years the assets of mutual funds have literally mushroomed, and even the closed-end funds have had some growth. During the same period, the number of shareholders has increased by 500%.**

**Vice-President, Research, Hamilton Management Corporation*

## Advertisers' Index



a preponderance of common stocks. The market levels will probably hold rather steady for the next few months, with minor dips and rises. This may be followed late in 1958 or early 1959 by a substantial rise. The management of many good mutual funds are taking advantage of the current market situation to add under-priced securities to their portfolios, which should give investors an opportunity for growth and profit in the coming years. We pointed out last month that the Dow-Jones average could easily rise to twice its present level in the late 1960's. Investors entering the mutual-fund field now should fare extremely well.

As far as starting a monthly investment plan is concerned, now is a good time—as is most any other time. Because with a monthly plan you take advantage of dollar cost averaging—with your fixed number of dollars buying more shares when prices are down and fewer shares when prices are high. This lowers the average cost of all shares. And a monthly investment plan is usually a long-term accumulation program, where little regard need be shown for day-to-day prices. By the time you have completed a 10- or 15-year investment program, the market will have risen and declined scores of times.

It is interesting to note that during the 1957 decline, and since, mutual-fund share sales have increased, even though the trading volume on the New York Stock Exchange is lower. Fund share sales are consistently running well over $100,000,000 a month, and cash-outs of shares have greatly decreased. There are approximately 18,000 new monthly investment plans started each month.

This follows a trend of growth that started about 1940, and has been particularly strong the past ten years.

If the present rate of growth of mutual funds continues, within a few years the funds will be a dominant factor in the stock market. They have already become a major factor in the lives of hundreds of thousands of families, who are looking to their investments in mutual funds to provide them the future financial security we all hope to have.

## Run Down of Key Contracts

### Army

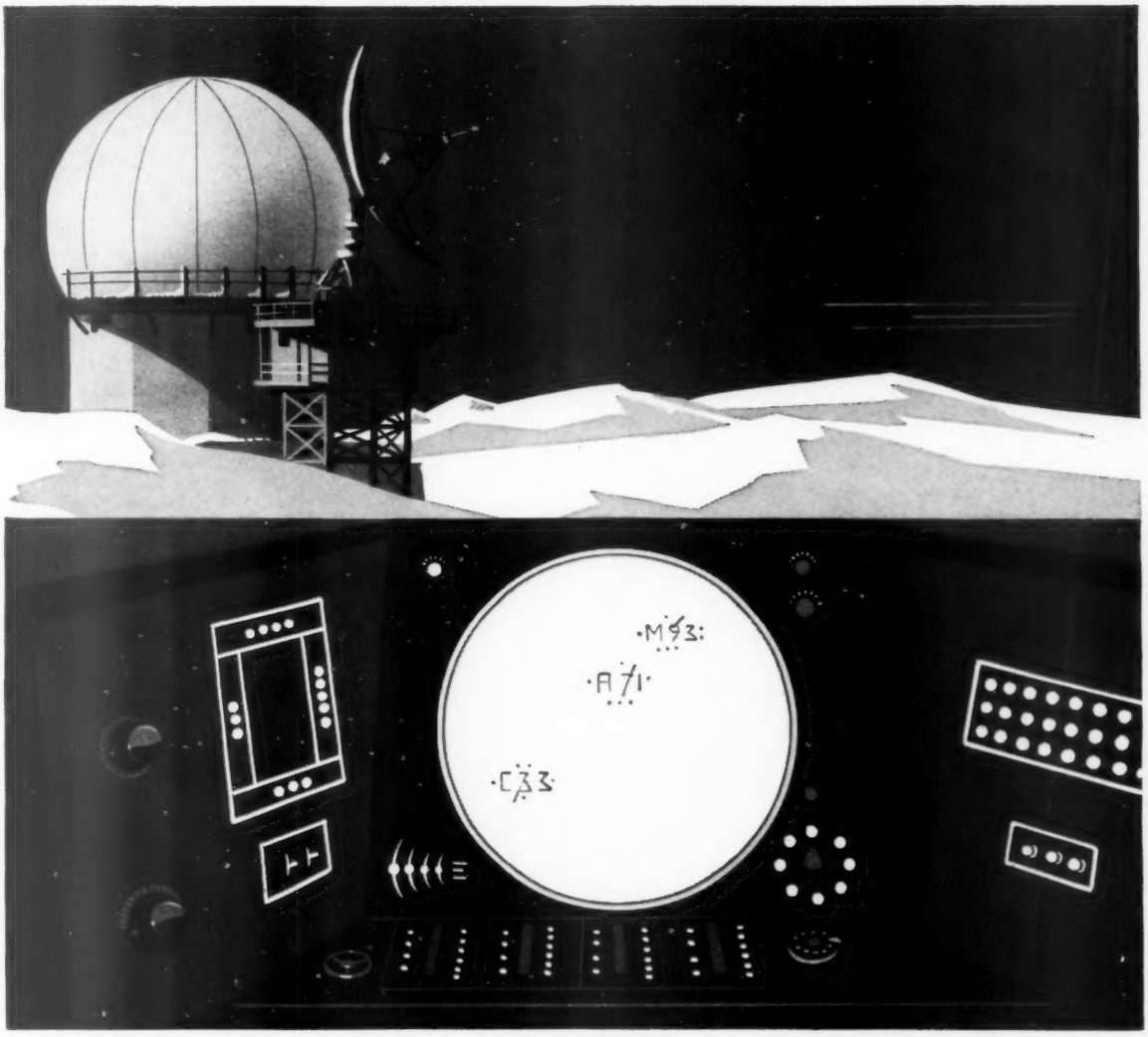
$850 thousand to **Wayne Pump Co.** for modification of Nike missile bases to handle larger and heavier Nike-Hercules.
$16 million to **The Martin Co.** for Lacrosse guided missile and related equipment production.
$100 million to four firms—**Willys Corp., Chrysler Corp., Utica Bend Corp.,** and **Mack Trucks, Inc.**—for military trucks and trailers.
$130 million to **Western Electric Co.** for production of Nike Hercules missiles and ground equipment.

### Navy

Development contract for undetermined amount to **Tube Turns Plastics, Inc.,** for field-test quantities of plastic cartridge case for artillery shells developed by Naval Ordnance Laboratory for the Army.
$6.5 million in extra funds to **Temco Aircraft Corp.** for continued development of Corvus air-to-surface missile.
$8 million to **Convair** for pilot line production of Tartar surface-to-air missile.

### Air Force

$584,000 development contract to **Servo Corp.** for five complete advanced versions of military infrared reconnaissance system.
$140 million to **American Bosch Arma** to produce Titan inertial guidance system.
$21-million development-production contract to **Sperry Gyroscope Co.** as system manager of a new radar program.
$10.5 million to **Collins Radio Co.** for airborne high-frequency communications systems.
$1 million to **Avco's Crosley Div.** for service-test quantity of closed-circuit TV sighting link adaptations for aircraft weapon systems.
$4.89 million to **Lear, Inc.,** for gyroscope indicators and shock mounts for F11F-1 aircraft.
$808,000 to **B. F. Goodrich** to spare B-47 wheels.
$1.1 million to **General Electric** for rate-of-flow transmitter.
$1.75 million to **Philco Corp.** for on-site maintenance for Eastern and Western Air Defense Forces, Air Defense Command.



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